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HEUSLER MAGNETIC ALLOYS.

The discovery made five years ago by Heusler that the addition of manganese to copper produced an alloy strongly magnetic raised a faint hope that useful results might come from this discovery. Up to the present time, however, no application of the magnetic property of these alloys has been made, and we are still entirely dependent upon iron in its various forms. The reason for this is that the new alloy is relatively poor magnetically when compared with iron, and, moreover, the metals entering into its composition are themselves more expensive than iron or steel. There seems to be little possibility of any developments in this direction, though the discovery suggested that it might be possible to produce an iron alloy of decidedly better quality than the steels used to-day. It will be remembered that this same suggestion followed from a discovery made several years before the magnetic quality of the Heusler alloys was noticed. This was that the addition of certain materials to iron tends to increase the resistivity and at the same time improve the permeability. It was suggested that it might not be impossible to cast armature and transformer cores without increasing the internal losses, and we might thus avoid the expensive and laborious methods to-day necessary in constructing these parts of our machines. However, all that has come of these discoveries is the production of a number of brands of special steel for electrical work, without any change in the method of construction.

Hence the interest in the Heusler alloys has been mainly scientific, and it is probably for this reason that the investigation of their properties has not been carried on more energetically. From time to time, however, a contribution to this subject is made. The latest of these is a paper read before the Royal Society of Edinburgh last fall. In this Mr. A. D. Ross described a number of experiments conducted in order to determine the effects of heat and cold upon the alloys. Heating the alloys slowly and allowing them to cool was found to increase the hysteresis loss, just as aging increases the loss in transformer cores, although a short, moderate heating caused a temporary decrease in the losses. Cooling increased the permeability; in fact, immersing the specimen in liquid air gave an increase of nearly thirty per cent, though this was only temporary. This increase, however, was followed with a slight increase in the hysteresis. When the specimen was allowed to stand it slowly returned to the original condition. It was found, however, that when a specimen was cooled, then heated and quenched in cold water, the permeability and the hysteresis effect were both

decreased. If the specimen was then cooled in liquid air it regained its original permeability without suffering a change in the hysteresis effect which had been decreased by the previous quenching.

These experiments seemed to be in agreement with the recent ideas regarding magnetization. A recent theory, suggested since the discovery of the Heusler alloys, is that magnetization is an effect of molecular grouping, and not a special property of the atoms, hence any physical treatment which might tend to change the physical state of the body should have a marked effect upon its magnetic properties.

A PROPOSAL TO ESTABLISH GOVERNMENT EXPERIMENT STATIONS.

The success which has resulted from the agricultural experiment stations maintained by the universities of many states, which are also liberally helped by the Federal government, has led to the introduction in Congress of a bill to establish engineering experiment stations at these universities under a similar arrangement. One reason for the success of the agricultural station is to be found in the methods which were commonly employed in farming. The greater number of farmers followed methods handed down to them by their fathers, and when any improvements or advances were made they were relatively slight and slowly transmitted from one section to another. Moreover, there was little opportunity for experimental work, and there were few farmers in a position to obtain specimens of seeds from other countries and to try these in the hope of finding some suitable for raising crops in this country. When the agricultural experiment stations were established, work of this kind was immediately taken up. Seeds from all over the world were secured, distributed to the various stations, and there they were tried under many conditions. As a result of this, a number of valuable additions have been made to the crops of this country. Besides work of this kind the experiment stations are usually conducted in connection with an agricultural school which teaches the scientific principles upon which farming depends. It can certainly be said that in many sections of the country there has been a very great improvement in farming methods resulting from these schools.

There is, however, a different situation in regard to the establishment of engineering experiment stations. The greater part of experimental engineering work is done by large and rich companies, who maintain staffs of experts for the purpose of conducting any special investigation which may be suggested in connection with the work of manufacturing and even for carrying out general researches in certain directions in the hope of making valuable discoveries. The results of this work are, of course, the property of the companies, and they are not generally made public, but are protected, when possible, by patents. If, on the other hand, work of this character were done in public institutions such as proposed in this bill before Congress, the results would be public property and any one who wished could benefit directly by them.

In addition to work of this kind such bureaus might conduct investigations for private individuals which they could not easily have done in other ways. There is a great deal of routine work, such as testing, calibrating, measuring instruments and apparatus of all kinds, and making special measurements, which small companies or individuals can not carry out on account of the lack of the necessary apparatus, and much work of a similar character.

The plan is not entirely new, as already a number of state institutions of the character proposed have been established, some of which have done really creditable work. The plan, however, involves an extension of the functions of the government, the propriety of which many will question. The need for institutions where scientific experiments may be conducted or special investigations carried out has led to the organization of private laboratories for just such purposes. The establishment of government experiment stations would create institutions entering into direct competition with these private laboratories. On the other hand, if there were a large number of experimental testing stations distributed throughout the country—one, say, in every state—the convenient opportunity offered for doing accurate and scientific work would, no doubt, often lead to the carrying out of investigations which would otherwise be neglected, and in this way result many times in improving apparatus or methods, to the direct benefit of the country at large. There are several sides of the question to be considered, and it is one in which every engineer is more or less interested.

SINGLE-PHASE DISTRIBUTING SYSTEMS FOR RAILWAYS.

The interesting paper presented by Mr. William S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, at a recent meeting of the American Institute of Electrical Engineers, which, slightly condensed, is published elsewhere in this issue, calls attention to a number of features related to the arrangement and operation of single-phase distributing systems for railway work. The New Haven installation is the most important single-phase system which has been put into service, and naturally the results of its operation during the past six months are of interest and importance.

When contemplating arranging this system several distributing schemes were available. For example, the line might be cut into sections and the power supplied to different sections from different phases of the three-phase generators, or single-phase generators might be adopted for supplying the single-phase operating current; or again, power for the railway system might be drawn from one phase only of three-phase generators. The latter scheme was the one adopted, the advantages being a simple distributing system for the railway, and yet three-phase currents would be available for all other power purposes involved in the operation of the road. This last feature is a controlling one, since there is a possibility of a considerable use of polyphase motors in the territory through which the system runs.

Another interesting feature of the paper was the discussion of the best way of dividing the system into sections. Here local conditions controlled, leading to the adoption of sections

considerably shorter than would be selected under ideal conditions. Five miles would not be too long if other considerations did not influence choice, but since the throwing out of any section of trolley would necessitate crossing over the trains from that track to another, the points where this is done naturally influence the selection of sections. The location of the signaling towers will also influence the choice of the trolley sections, for, as was pointed out, although the signaling blocks may not be as long as the trolley sections, it seems desirable that each end of a section should be at one of the signaling towers. There are a number of advantages obtained in this way; no special attendants would be required at the section switches, as the signal operators could look after the section switches. This Mr. Murray believes is a great advantage, because it puts the control of these important auxiliaries in the hands of men who are accustomed to railroad operation and who would, therefore, know what to do to keep the trains moving whenever it was necessary to cut out any section of the trolley. Another advantage of this arrangement, which might occasionally be of the utmost importance, is the possibility of cutting off power from any section of the road should a train run past a danger signal, or to prevent an accident due to a wrong signal. Should such an event threaten, the signal operator could disconnect the end of the trolley wire at his tower and telephone to the operator at the other end of the section to do likewise. The section would thus be rendered dead and the train or trains would come to a stop until communication could be established.

It may be noted that Mr. Murray believes a reliable telephone system to be essential for operating electric railway systems. This is required, not only for communicating between signal towers, but for directing the work of inspectors and repair men. This, also, is adding to the responsibility of the signaling department, as it brings a new system of communication under its control.

This phase of electric railway operation is interesting and suggestive. It indicates that the signaling branch of the road may become still more important, as it may not only be responsible for ordering the train movements, but will actually have control over the power supplied for moving the trains. It has been suggested at various times that some such scheme would be necessary if high-speed lines, making, say, one hundred miles an hour, should be undertaken. The plan might be carried a step further without much difficulty, the arrangement being such that the power would automatically be cut off from a train should it enter into a danger zone. It seems evident that the new conditions introduced into railway practice by the use of the new power will make necessary, or desirable, certain rearrangements of the different departments. It has already created a new department, or rather two: one responsible for the generation of power and the other having the care of the distributing system. It might be found desirable that the latter department should be put under the direction of the signaling department, for if the signaling department is to say when and how power is to be supplied to the train, it should also decide when repairs should be made. In another sense this perhaps is desirable, as since the development of the signaling department has, during the last few years, been largely along electrical methods, it probably is more familiar with the requirements of electrical apparatus than any other department of the steam railroad.

THE ARC IN WIRELESS TELEGRAPHY.

An interesting article describing a new telegraph station erected on the east coast of England by the Amalgamated Radio-Telegraph Company was published in the *Electrician* (London), December 20. This station uses the de Forest spark apparatus and also the Poulsen apparatus, which utilizes the oscillating arc for setting up electric waves. It is the description of the latter apparatus which is of particular interest. Due to the fact that the ordinary commercial supply may be utilized, the apparatus requires very little space, as no special generating equipment is called for. Of course, if alternating currents only are available, a direct-current generator, driven in some way, would be necessary for operating the arc. The remainder of the apparatus consists of a special arc lamp enclosed so that the arc may be surrounded by an inert atmosphere, and a few condensers and inductance coils. The receiving apparatus is also comparatively simple, a resonant circuit being all that is necessary to catch the signals. To render these distinct in the telephone, however, a little device is needed, because the period of oscillation is too high for the telephone diaphragm to respond to. This is a little vibrating switch or relay called a "ticker," which is closed by the oscillating currents set up in the receiving circuit, and which discharges a condenser through the telephone, thus producing an audible signal.

One striking feature of this equipment is the noiselessness with which it operates. In spark telegraphy there is always a more or less loud report with each discharge, and where high-power stations are operated, the noise is very considerable. There is nothing of this kind in employing the arc lamp, for the oscillations set up by the latter are entirely inaudible, and they are impressed upon the antenna continuously. To send out the signals, all that is done is to change the frequency of these oscillations so as to bring them to the proper pitch, which is done by short-circuiting a few turns of the inductance coil by a telegraph key. There is no sparking at the switch, and the whole system seems wonderfully simple and effective so long as the arc itself is maintained in the proper condition.

This method of operation, by simply changing the wavelength of the oscillations, is neat, but it will probably cause some trouble if many stations are to be operated at the same time in any one neighborhood. In other words, electric waves of two frequencies are set up, each of which is capable of producing interference at other stations. On the other hand, if it be shown that the oscillations set up by the arc are more nearly harmonic than those given out from a spark system, tuning can be carried out more accurately, and there should be really less trouble from interference.

THE NEW HAVEN SYSTEM OF SINGLE-PHASE DISTRIBUTION, WITH SPECIAL REFERENCE TO SECTIONALIZATION.[1]

BY W. S. MURRAY.[2]

The method and distance chosen for sectionalizing the high-tension wires supplying power for alternating-current traction are worthy of careful consideration. Local conditions play so important a part in the correct conclusion of method and proper distance to be applied, that no precedent or convention can be followed and standardization is quite out of the question.

In advance of taking up the concrete subject at hand, doubtless it will be of interest to touch upon several alternative distributing systems that were considered by the engineers of the New Haven road before the final adoption of the system of single-phase distribution and sectionalization now in service. Some of these were:

1. Eleven-thousand-volt, three-phase generation at the power-house; transmission along the right of way at this voltage; step-down transformers furnishing trolley voltage at 3,300; track mileage divided into three equal linear parts, each part being supplied by an individual phase.

2. The same arrangement as 1, with the exception that step-down transformers furnish 6,600 volts to the trolley.

3. Eleven-thousand-volt, three-phase generation at power-house; transmission along the right of way at this voltage; track mileage divided into two equal linear parts, each part having its trolley connected through the transmission line to one of the three terminals of the power-house bus-bars, the remaining bus-bar being connected to the tracks, thus making a common connection for the two trolley sections.

Diagrams 1, 2 and 3, Fig. 1, represent in the simplest form the three above-described arrangements. It follows, of course, that the phased divisions in each case could be further individually subdivided into sections wherever desirable. The presentation of these three methods of distribution by no means prescribes the limit of combinations that may exist, as many others of an interesting character have been suggested.

4. Eleven-thousand-volt, three-phase generation, transmission along the right of way at this voltage, only one phase being applied to all sectionalized trolley wires throughout the zone of electrification. The three phases are also carried throughout the electrification zone, and are at all points available for polyphase motors, such as would be used in railway machine shops and for the operation of motor-driven generators in local direct-current railway plants owned by the railroad company.

In Diagram 4, Fig. 2, there is shown diagrammatically the actual scheme of single-phase distribution which has been adopted, and is now in service.

There are advantages to be gained in any one of the above-mentioned alternatives, but the single-phase distribution as described under 4 carries with it advantages, the sum of which far outweighs the sum of the advantages in the others. In a word, the distribution, as described under 1, 2 and 3, would seem to offer a better opportunity to distribute the load in the three-phase windings of the generators, and yet this is open to question on account of the possible unequal distribution of trains in the individual phased sections; but the greatest and deciding disadvantage to any of the three-phase distribution schemes is the complication that results in the overhead system, together with the fact that for an equal weight of overhead copper the efficiency of the single-phase system is higher than any of the polyphase arrangements. From the foregoing, I believe it will be generally conceded that the single-phase scheme of distribution is the best.

A modification of arrangement 4, which was considered, may be mentioned, namely, 11,000-volt, three-phase generation, single-phase distribution for traction with step-down transformers distributed along the line, their secondaries furnishing 3,300 or 6,600 volts to the sectionalized trolleys. For the reason that the life-hazard in using 11,000 volts was not considered to be greatly increased over that of 3,300 or 6,600 volts, and in view of the higher efficiency, lesser currents to be collected by locomotive shoe contacts, greater reliability, and the lower operating costs (no transformer substations) the advantages of the 11,000-volt direct transmission to the sectionalized trolleys was immediately apparent, and the problem became simply one of insulation.

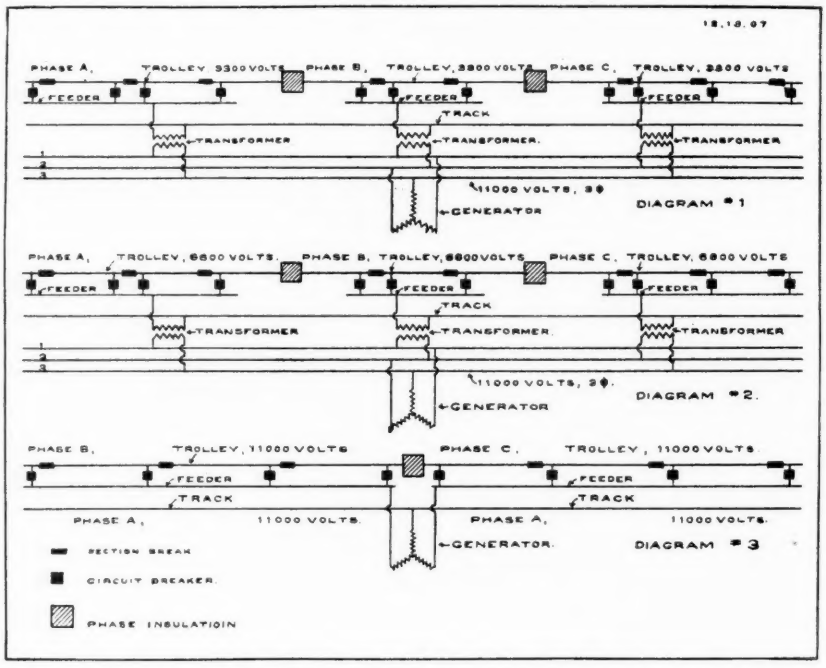


FIG. 1.—DIAGRAMS OF THREE POSSIBLE SYSTEMS OF DISTRIBUTION NOT ADOPTED FOR THE NEW YORK, NEW HAVEN & HARTFORD RAILROAD.

As concerns the choice of three-phase generators in connection with single-phase distribution for traction purposes, again local conditions were the real factors that framed this conclusion. Single-phase or balanced polyphase voltages are undeniably more desirable than unbalanced ones; at the same time when proper allowance and arrangement are made for the unbalanced voltages, and there is a decided market for polyphase power, it is difficult to escape the conclusion that it is a desirable and necessary adjunct to the system. In connection with its application to the New Haven electrification, it may

[1] From a paper presented before the American Institute of Electrical Engineers, New York, January 10, 1908.

[2] Electrical Engineer, New York, New Haven & Hartford Railroad.

be said that synchronous motors will be shortly substituted for steam engines in one of our lighting plants. Such arrangements will bring about the centralization of power generation, and by proper field adjustment of the synchronous motors the general power-factor of the single-phase system will be raised.

An examination of the electrical connections made in and on the power-house, line, and locomotives would bring out the strong similarity of the New Haven system to the well standardized direct-current (not alternating-current-direct-current) system. Indeed, I think it can be fairly said that the current in either case has the same path to follow; the only differences lie in the nature of the current (alternating and direct) and the voltage. In either case the path is from one bus-bar of the station to the feeder and trolley, thence to the locomotive and from there to the rail and return to the other station bus-bar. In the alternating-current system are noted, of course, methods of installation common to high-tension practice.

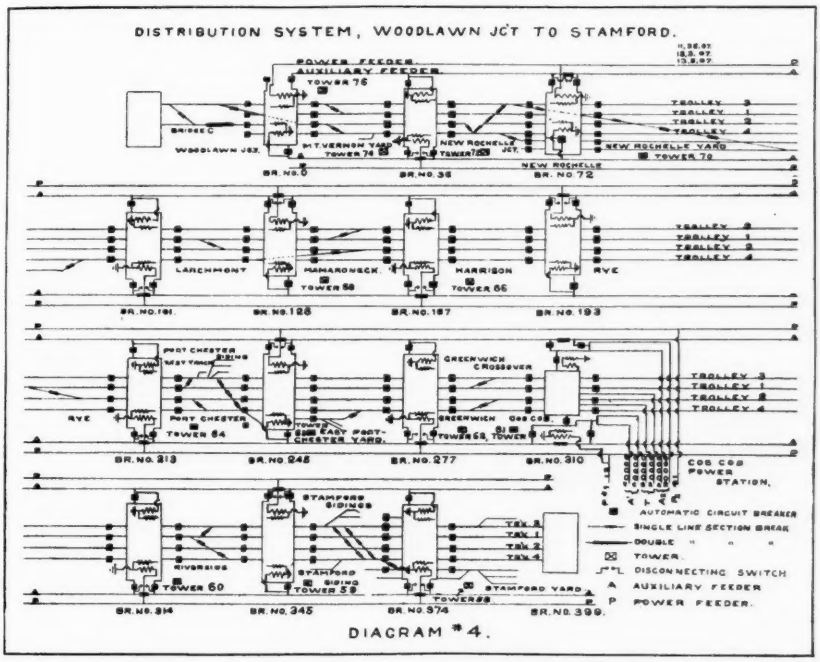


FIG. 2.—THE ACTUAL DISTRIBUTION SYSTEM INSTALLED ON THE NEW HAVEN RAILROAD.

Single-phase distribution offers an excellent opportunity for sectionalizing. As may be seen in Diagram 4, Fig. 2, the system consists simply of the track trolleys, two auxiliary wires immediately adjacent, and the necessary switching complement. Although these auxiliary wires have been called feeder wires and while, as a matter of fact, they do serve to increase the capacity of the overhead system, this is not their principal function, as the amount of copper included in the trolleys would suffice to be within the economic figures of copper loss. The auxiliary wires are installed to serve as by-passes, in the event of it being desired to cut dead any or all of the trolley wires in any section. Thus by this system of auxiliary by-passes any degree of sectionalizing can be used, and any or all trolley voltages in sections can be removed without interrupting the continuity of the voltages throughout the zone.

The lengths of sections are governed entirely by local conditions. No two sections of the fourteen that exist in the twenty-one miles of New Haven electrification are the same. It is seen, however, from these figures that the average length of sections is 1.68 miles, that none of these is over 2.19 miles or less than 1.07 miles.

The best reason that can be assigned for the use of sections is in order that line troubles may be localized. There are many others, and some of a most important character. Indeed, it may be said that were the line absolutely immune from trouble, such as grounding, mechanical failures, etc., there would still be many good reasons for sectionalizing it, and these reasons will develop as the subject is further studied.

One of the most attractive features of single-phase distribution is the elimination of substations with their fixed and operating charges, and unlike the alternating-current-direct-current scheme of distribution, where the length of section is settled by the equation of load and copper to meet it, the single-phase system is not bound by these limiting electrical conditions. Line-loss is forgotten in the establishment of a mechanical construction, the amount of copper in which is only a fraction of the amount required for an equivalent loss for the same amount of power transmitted in the alternating-current-direct-current systems. This convenience of transmission with low loss permits sectionalizing *ad libitum* and the local conditions are accorded almost the entire privilege of decision. The advantage of such a relation between operation and distribution was immediately apparent to E. H. McHenry, vice-president of the New York, New Haven & Hartford Railroad Company, whose suggestion that the electrical and train-signal blocks be made co-terminus was adopted. It will be noted, then, that of the fourteen electrical sections between Woodlawn and Stamford, nine of these are co-terminus with the signal towers. In each of these towers there is installed a small panel containing the pilot-switches controlling the trolley (and by-pass) circuit-breakers installed on the anchor bridges. Aside from the economical features of this scheme of control, as no operators other than our present signal operators are required, the value of placing the distribution in the hands of this class of men is most important, their constant attention to matters pertaining to the operation of trains bringing about the attention which should be accorded to the distribution of current; their thorough understanding of the conditions of traffic on the various tracks permitting the most intelligent handling of electrified and de-electrified trolleys, assuring at once prompt and reliable service in the matter of handling a situation when cross-overs have to be made on electrified tracks, and while repairs are being made on others from which the voltage has been removed. The value of placing the distribution system in the hands of the signal operators may be again illustrated by saying that should an electric train run past a stop-signal set by the operator, or should the operator desire to stop a train in his block, he has only to trip the pilot-switch controlling the trolley circuit-breaker, from which the train is drawing its power, and signal the operator in the adjacent tower to do likewise. The individual value of this protective perquisite is an illustration of the

use of sectionalizing outside of the question of line troubles.

In the discussion of sectionalization it would seem proper, instead of specifying the length of sections, to specify the number to be used over a given total distance; their individual length varying in accordance with the local conditions peculiarly related to them. Upon this basis, it will be interesting to enumerate the following advantages and disadvantages peculiar to a choice of a "small number" and a "large number" of sections over a given distance. In this table it should be remembered that usually the items of advantage for the "small number" of sections will be items of disadvantage for the "large number," and *vice versa*. Also it is assumed that the signal towers along the right of way average about one and a half miles apart and that electrical sections of this length, or longer, will be classed as a "small number," and sections shorter than this will be classed as a "large number."

A tabulation of the advantages and disadvantages of the use of a "small number" against a "large number" of sections is as follows:

SMALL NUMBER.

Advantages.	Disadvantages.
1. Co-terminus tower scheme more easily arranged.	1. Difficulty of locating grounds increased.
2. Fewer switches to maintain.	2. Greater section of track cut dead in case of ground or other trouble. Disadvantage, however, related to cross-overs.
3. More reliable: due to less frequent grounding of line.	3. Larger section breakers required.
4. Less cost.	

In advance of a discussion of the items in the above table it is fair to assume that convenience of construction of the apparatus required for either the long or short sections may be equated. That is to say, the work-train service, in either case, would be about the same, and the structures to be put up of a character which would require much the same general superintendence and engineering.

In the case of the long sections, it would, of course, be necessary to splice the messenger cables, as they could hardly be manufactured on single reels greater than two miles in length, but the splicing process would not be a matter of great inconvenience, and would not detract from the value of the cables.

On the other hand, in the case of the shorter sections a greater number of anchor bridges would be required for the supply of sectionalizing switches, but this form of structure would not increase, to any extent, the difficulties of erection, nor would the placing of apparatus upon them interfere with regular traffic.

Taking up the discussion of the above tabulation of advantages and disadvantages for the small number of sections *versus* the larger number; or, stated in another way, sections of greater length *versus* sections of shorter length, we note under "advantages":

1. Co-Terminus Tower Scheme More Easily Arranged—In my estimation this is by far the most important factor favoring a small number of sections. It is quite clear that with a great number of sections, their termini would fall at points between towers, necessitating some form of substation or building for the electrical operators. This would be inconvenient, both for the railroad company and the operator, on account of the cost of maintenance and operation for the former, while the latter would be far removed from his living point.

The reason that the co-terminus scheme is more readily arranged with the use of long sections is apparent, in view of the fact that no convention is necessary to be followed in regard to standard distances, it being at the option of the engineer to choose such towers as are already located on the line as the termini of electrical blocks.

2. Fewer Switches to Maintain—This advantage is immediately seen, in view of the number of switches being directly proportional to the number of sections, and I believe there is general agreement that a switch in any line does not increase the reliability of that line.

3. More Reliable; Due to Less Frequent Grounding of Line—At the present stage of the art, the anchor insulators, which have given the best results from a combined mechanical and electrical strain point of view, have been of corrugated cylindrical form. In this form their insulating value is unquestionably less than the mushroom or petticoat type of insulator, and experience indicates that they are very much less reliable than the mushroom or petticoat type (this form of insulator is used to support the messenger cables on intermediate catenary bridges). It is my belief, however, that by suspending some form of protective shield or petticoat from the anchor insulator, its insulating value will be greatly enhanced. The blast from steam locomotives seems to produce a very rough enamel of coal dust and cinders, which, on account of deeply embedding itself in the insulator, is almost impossible to remove, in consequence of which insulating values are greatly reduced.

4. Less Cost—It is immediately apparent that the cost would be much less on account of the elimination of a larger amount of switching apparatus and the heavy bridge work required at all anchorages.

In the table of "disadvantages" we note:

1. Difficulty of Locating Grounds Increased—This is quite apparent, in view of the fact that there are a greater number of insulators between the circuit-breakers, but experience in actual operation has indicated that this is not a serious matter, as the offending insulators are very quickly located, and there is also being perfected at this time a resistance scheme of measurement by which the point of ground can be approximated within five per cent of its actual location; and upon the perfection of this apparatus this difficulty will be eliminated.

2. Greater Section of Track Cut Dead in Case of Ground or Other Trouble; Disadvantage, However, Related to Cross-Overs—This trouble would be of a more serious character if it were railroad practice to include a great many cross-overs on the main line. The average distance between cross-overs on the New Haven road is even greater than the distance of the electrical blocks; in consequence of this, should a section become dead on account of a ground, it is possible that the train would have to cross over at a distance from the trouble greater than the length of the electrical section. Railroad engineers look upon cross-overs as a necessary evil (remembering their high cost of maintenance, together with the necessity of interlocking machines in conjunction with them) and it is fair to assume that their distance apart will not be decreased for the convenience of shortening the electrical sections; hence, this difficulty can not be classed as one of special moment.

3. Larger Section Breakers Required—In the use of longer sections, it is apparent that more trains may be drawing power from the section breakers, in consequence of which it is necessary to design them for greater capacity and they will be called upon to open larger propulsion currents. The difficulty of this, however, fades in the maximum demand upon the breakers being a short circuit, and as this is a duty a section breaker of any capacity has to stand ready to perform, this objection might be considered as not existing.

In regard to principles which have governed in the electrification and sectionalization as adopted by the New Haven road, I have found by careful inquiry into the opinion of those who are re-

sponsible for the operation of our electric trains and the distribution of currents to them, that if any change were to be made, possibly some advantages would accrue in the use of a longer section.

In regard to form of construction. It is fair to say that there are many changes that can be and are being made, which will greatly increase the efficacy of distribution. We have encountered unexpected difficulties. None of them, however, has been of a character which could be interpreted as a menace to the general principles involved. The difficulties have either been corrected or their correction is easily in sight.

The last six months of operation have offered the opportunity for a collection of valuable data, and the following observations and recommendations are offered in the hope that they may be of some value to other engineers interested in the electrification of steam roads:

1. In one, two, three, or four-track railroads, the single-phase distribution should include besides the trolley wires, by-passes or feeders.

2. Electrical sections should not average less than 1.5 miles in length; greater averages are entirely acceptable and individual lengths should be governed by local conditions.

3. Twenty-two feet is a safe general working distance of trolley from rail.

4. The de-insulating effect of steam locomotives' stack discharges is a most important consideration to be kept in mind in the matter of properly insulating high-tension wires from ground.

5. High-insulation factors should be used where high-tension construction due to low bridges is brought nearer the rails than the normal height of twenty-two feet. Strong mechanical shields should be used to deflect locomotive blasts from messenger insulators at low bridges. Care should be exercised in the installation of these shields so that high-tension conductors and ground are at safe working distance. Wherever possible insulators should be installed away from the direct line of the locomotive blast.

6. Auxiliary wires in connection with the electrification, if they can not be carried over highway bridges as aerial conductors, should not be carried under, unless they are enclosed in lead-covered cables, with end-bells properly enclosed in suitable housings at points where the conductors change from aerial to lead-covered cables.

7. All circuit-breakers connecting feed wires (or by-passes) to the trolley bus-bars should be equipped with time-relays, so that any short-circuit will immediately open the trolley-breakers, thus locating the trolley section grounded. Equipping the feeder-breakers with time-relays insures continuity of voltage on wires not affected by the short-circuit. Each trolley-breaker pilot-switch should be provided with a light to indicate when it opens, and an announcer bell should ring in the signal tower at the same time so that the operator is promptly notified.

8. On account of deleterious influences of weather and locomotive stack discharges, together with general inconvenience of getting at bus-bars and switches when installed on anchor bridges, all section oil-switches should be installed in switch houses erected at the side of the tracks, with lead-covered cable connections between trolley and switches.

9. Signaling should be arranged so that the operator can prevent the engineer from spanning two sections by his locomotive shoes in the event of the advance section being grounded.

10. All signal towers should be interconnected with a reliable telephone service. Immunity from electromagnetic and electrostatic disturbance in the telephone system can be secured by using twisted-wire pairs enclosed in lead-covered sheath, the sheath being grounded frequently. This suggestion is more particularly applicable to the interrupted or tower-to-tower telephone system. In this case the distance of exposures of the telephone wires is not great, and thus the summated effect of electromagnetic induction is negligible. In the case of the through telephone line where the circuit is uninterrupted throughout the zone of electrification, again the lead sheath and twisted pair are respectively effective in removing all static charges, and electromagnetically balancing the circuit; but on account of the cumulative action of the electromagnetic induction, either compensating transformers or a system of impedance coils installed across the telephone circuits at intervals of two miles (this distance may be less, depending on the electromagnetic density) with their central points grounded should be used. Either method will satisfactorily remove the impressed voltage due to electromagnetic induction. The importance of reliable telephone service between operating towers can not be too greatly emphasized.

The observations and recommendations above cited are those that have been impressed upon the writer during the period of operation so far attained. Except for certain minor and easily remedied details, experience to date with the New Haven arrangement of single-phase distribution would indicate that the fundamental principles involved have been correctly applied.

National Society for the Promotion of Industrial Education.

The annual meeting of the National Society for the Promotion of Industrial Education was held at Chicago, Ill., January 23, 24, and 25. The technical meetings were preceded by a dinner at the Auditorium Hotel on January 23, when addresses were made on the topic "Industrial Education as an Essential Factor in Our National Prosperity" by Dr. Charles W. Eliot, the Hon. Edgar E. Clark, Mrs. Anna Carlin Spencer and James W. Van Cleave. Dr. Henry S. Pritchett, the president, discussed the aims of the society.

The first business session was held at the Art Institute on January 24. The following was the programme: "The Apprenticeship System as a Means of Promoting Industrial Efficiency," by the Hon. Carroll D. Wright; "The Apprenticeship System of To-Day," by W. R. Warner; "The Value of a Thorough Apprenticeship to the Wage-Earner," by James O'Connell; "Trade Instruction in Large Establishments," by J. F. Deems; "The Necessity for Apprenticeships," by Leslie W. Miller.

The second session was held on Friday afternoon with this programme: "The Place of the Trade School in Industrial Education," by the Hon. Horace E. Deemer; "The Effect of the German Trade-School System Upon the Development of German Industries," by Victor C. Alderson; "The Trade School as a Part of the Public-School System," by Charles F. Perry.

The third session was held upon the evening of January 24 with the following papers on the programme: "The Wage-Earner's Benefit from Industrial Education," by Dr. Henry S. Pritchett; "The Social Value of Industrial Education," by Miss Jane Addams; "The Development of Industries Depending on an Adequate Supply of Industrially Efficient Workers," by J. W. Kendrick; "The Attitude of the Wage-Earner Toward Industrial Education," by John Golder; "The Moral Value of Industrial Education," by Dr. Emil Hirsch.

The concluding session will be held on January 25, the topic for discussion being "The True Ideal of a Public-School System That Aims to Benefit All," in which L. D. Harvey, Samuel B. Donnelly, Charles H. Morse and the Hon. Charles R. Davies will participate. This will be followed by the annual business meeting of the society.

COOLING TOWERS.

BY CHARLES L. HUBBARD.

Cooling towers were introduced into this country about fifteen years ago, and since then have been installed in connection with a large number of power plants.

The economy of a condensing system has been shown in a previous article, but in the cases cited it was assumed that the water for condensing purposes could be obtained free of charge. As a matter of fact this is not always the case, and it may either have to be purchased at city rates, or pumped a long distance, thus offsetting, to a greater or less degree, the advantages of condensing. From this it is evident that any device which will successfully furnish a constant and reliable quantity of cold water at a very small cost, where a natural supply is either lacking entirely, or is of such a character that its use is attended with damage to pumps and condenser, must interest all steam users.

The cost of condensing water at city rates may in some cases greatly exceed the saving made by the use of a condenser—for example, a 500-horse-power engine requires three pounds of coal per horse-power per hour, or a total of 1,500 pounds. If, by the use of a condenser, a saving of twenty per cent can be made, it will result in a saving of 300 pounds of coal, which at $4 a ton would amount to sixty cents an hour.

Suppose when running condensing that the engine requires fifteen pounds of steam per horse-power per hour, or a total of 7,500 pounds, and that thirty pounds of condensing water are required per pound of steam condensed. This will call for 28,000 gallons, approximately, per hour, which at, say, ten cents per 1,000 gallons, would amount to $2.80 against sixty cents saved by condensing. If, now, some arrangement could be used whereby the amount of condensing water could be reduced ninety per cent, or more, its cost would be reduced to twenty-eight cents, which would result in a saving of thirty-two cents per hour, instead of a loss of $2.20, as above. Such results, and even much better, may be obtained in many cases by means of a cooling tower, whereby the same water is used over and over again, and simply replacing that which is lost by evaporation.

Again, when the cooling water is drawn from a river or pond it is likely to contain more or less gritty material which rapidly cuts out the pistons and cylinders of the pumps. The matter of freezing is also one of importance, as the supply of condensing water is liable to be cut off by ice in winter time. Again, the suction is sometimes lost on account of low water, especially in the case where rivers which are subject to a considerable rise and fall are the sources of supply.

These various objections are overcome by the use of a cooling tower, and the presence of an ample supply of water, at practically ground level, allows the condensing apparatus to carry large overloads without loss of suction. Freedom from foreign material permits the use of a more complete spraying device in the condenser, if the jet type is used, and a higher efficiency follows. Furthermore, the durability of the condenser is increased as the water usually contains the oil from the cylinder lubrication of the main engines and is free from any material which can wear the moving parts.

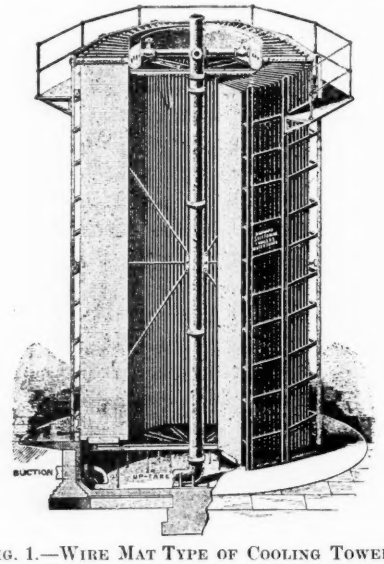


FIG. 1.—WIRE MAT TYPE OF COOLING TOWER.

Another important advantage is the selection of a site for a power plant without regard to a natural supply of condensing water. This allows more attention to be given to the coaling facilities, distribution of the electric current, and also makes it possible to erect the plant on cheaper land away from expensive water fronts.

Plants located where water systems are available simply buy the small "make up" water necessary, at meter rates.

It is the total of the various points mentioned above, rather than any particular one, which has proved valuable in the every-day running of a steam plant. There is nothing so objectionable as the loss of vacuum through the stoppage of the water supply. Even if the station can carry the load with the engines running non-condensing they will be at a great disadvantage and this may at times result in a serious disarrangement.

The principle upon which a cooling tower operates is simply the spreading of the circulating water in such a way as to bring the greatest surface in contact with moving air currents.

The cooling effect depends upon three processes: First, radiation from the pipes and sides of the tower; second, the contact of cool air with the heated water; and third, evaporation. The last, however, is much the most important. In actual operation the water coming from the condenser in a heated condition, when exposed to the air, is enveloped in a coating of vapor, which is carried away by the air currents in contact with its surface.

This vapor is constantly replaced and carried away by successive contacts with fresh quantities of air. The capacity of air for absorbing vapor depends upon the quantity of moisture which it already contains, called its relative humidity.

When the air is dry its heat-absorbing capacity is high as compared with a similar quantity of air at or near the point of saturation. As already stated, part of the cooling is done by radiation, especially during the winter season, and part by the contact of the water with the cooler air, but the bulk of the work is due to evaporation, since the evaporation of one pound of water carries away about 1,000 heat units. From the action of the apparatus it is evident that the only water required after it is once in operation is that necessary to replace what is lost by evaporation. With the best forms of cooling towers the temperature of the circulating water may easily be reduced from forty to fifty degrees, depending upon the season of the year, and with a loss by evaporation not usually exceeding from three to five per cent of the total quantity of water passing through the tower.

The proportion required for cooling by evaporation alone can be easily calculated as follows: The latent heat of evaporation at 110 degrees is about 1,035 British thermal units; that is, 1,035 heat units are absorbed in changing one pound of water from a temperature of 110 degrees into vapor at the same temperature.

Now suppose we wish to cool 100 pounds of water forty degrees. This will evidently require the removal of $40 \times 100 = 4{,}000$ heat units. If the evaporation of one pound of water will absorb 1,035 heat units, then $4{,}000 \div 1{,}035 = 3.86$ pounds, which is the amount required for evaporation to remove 4,000 heat

units, and therefore represents the loss necessary to cool 100 pounds of water forty degrees. That is, 3.86 pounds of water will be evaporated for every 100 pounds cooled forty degrees in passing through the tower. This will be reduced somewhat by radiation and conduction.

Cooling towers are usually one of three general types, known as the tray type, the stack or flux type, and the fan type.

Tray towers consist of large trays usually of wood, and slightly inclined so as to cause the water to run from one to another.

The hot water from the condenser is

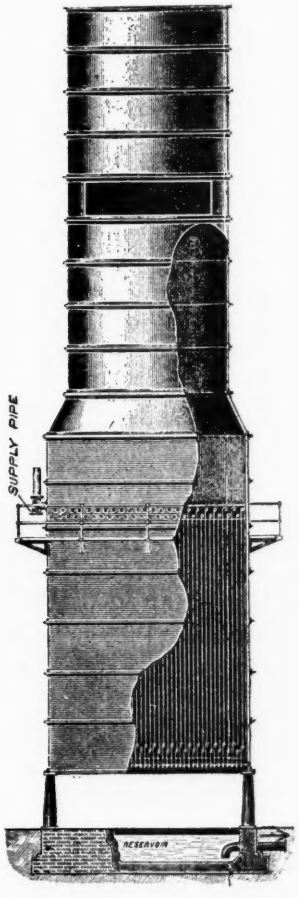


FIG. 2.—FLUE TYPE OF COOLING TOWER.

evenly distributed over the top tray and flows in a thin film over the broad surface, dropping from the end to the second tray, and so on to the bottom of the tower.

Here the cool water collects in a reservoir from which it is pumped to the condenser and used over again.

In certain makes the trays are perforated with narrow slots or holes, a portion of the water passing through these openings to the tray immediately below. This tends to break up the water and renders the cooling process more rapid. Provision is made for preventing the wind from blowing the water away, as it falls from tray to tray, by some form of wooden housing which permits the free circulation of air without admitting currents strong enough to interfere with the proper flow and breaking up of the water. In this form of tower the cooling is usually done by natural air currents, no fan ordinarily being employed for producing circulation. Another tower operating upon the same principle is shown in Fig. 1, in which the trays are replaced by a large number of mats made up of a special steel wire cloth, galvanized after weaving. The mats are practically equivalent to a metallic sponge, capable of holding a large quantity of water in suspension, which accumulates and drips off into the tank at the bottom.

If a fan is used for forcing the air over the mats, a steel casing is placed around them. The hot circulating water from the condenser is pumped up through a central standpipe from which it is led to a trough and distributing pipes, thus insuring the constant flow of a thin film of water over the cooling surface. Provision is made to operate parts of the tower when the load varies, or when repairs or cleaning are necessary.

The average height of a tower of this kind is about thirty feet, and the weight per square foot of foundation low, thus making it possible to erect it upon a roof if ground space is not available.

The increased pump duty on a roof tower is simply that due to the height of the tower itself, and not to its elevation above the condenser, because the columns of water in the discharge and suction pipes balance each other below the reservoir at the base of the tower.

A form of the flue type is shown in Fig. 2. This is also a fanless tower with a steel casing which extends in the form of a flue or chimney for a considerable distance above the mats, thus producing a natural draft without the use of a fan. This design is intended for location between buildings or in back yards, or on the roof of low buildings surrounded by higher ones. Another feature which makes this type sometimes favored in large cities is the absence of precipitation, which in some cases might prove a nuisance.

The fanless tower has the advantage of not requiring any expenditure of power to provide air circulation, and there is also another advantage in that the rising warm vapors condense on the inside wall of the chimney and flow back into the cooling tower. In order to get a strong air circulation it is necessary to have the vertical extension or stack of considerable height, for the same reason that boiler chimneys must be high in order to produce a strong furnace draft.

Another form of tower, of the fan type, is shown in Fig. 3. This is open at the top and there is an open space at the bottom above the receiving tank; between these two open spaces are several layers of short cylindrical pieces of tiling, set vertically, and entirely filling the body of the tower. The lower layer of tiling rests upon a grating support for ease of access for the air from below, and the tiles in

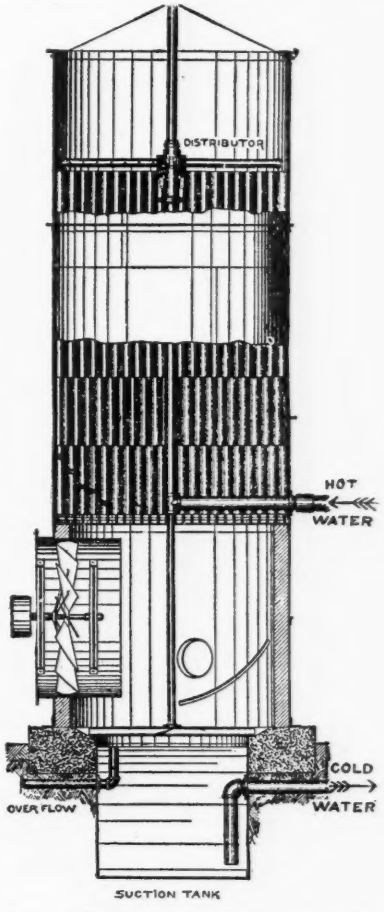


FIG. 3.—FAN TYPE OF COOLING TOWER.

each layer, which are packed as closely together as possible, are so arranged with regard to those in the next layer below as to break-joints and so break up the currents of air and water in order to cause a more thorough contact between them.

In this way both the water and air undergo a new distribution each time a new layer of tiles is reached, and the water, entering at the top, spreads over the tiles and thus exposes a very large evaporating surface.

The water is discharged over the top layer of tiles by means of a rotating dis-

tributor. This consists of a series of radial arms of pipe projecting from a hub pivoted on the top of the discharge pipe. The water flowing from small openings in the sides of the pipes causes the distributor to rotate, and thus every portion of the tile filling receives its proportion of the falling water.

The circulation in this type of cooling tower is furnished by means of a disc fan located near the bottom, as shown.

The fan tower has the advantage that it may be forced beyond its rated capacity if necessary. By driving the fan above its normal speed the tower may be made to cool a much greater quantity of water than usual, in case of an overload or other emergency. This flexibility is also of advantage in adjusting the apparatus for use during the different seasons of the year. While the power required to operate the fan is a constant expense, still by running it at a reduced speed when the load is light or the weather cold, and by returning the heat of the exhaust steam from the fan engine to the boiler by means of the feed-water, the actual charge is reduced to an almost inconsiderable amount.

The cooling tower shown in Fig. 4 is similar in construction to those already described, except that the interior surfaces are made up of metal plates so perforated as to form ledges over which the water flows very slowly. These plates are set at a slight angle with the vertical, and are so arranged that the water after passing over one is delivered to the top edge of the plate below, as shown in Fig. 5. It will be noticed that the plates are arranged in a zig-zag fashion, which prevents the water from flowing to one side of the tower, as would be the case if they all sloped in the same direction. The air, too, is thus given a free passage in an opposite direction from the flow of water.

There are various other devices used for cooling the condensing water, which may be used as circumstances would seem to indicate. Sometimes space is available on the premises for a small pond, into which the water may be discharged from the condenser pump. If the exposed surface is made sufficiently large, cooling may take place by radiation and evaporation. Where less space is available the water may be sprayed into the pond through a series of small nozzles connected with a pipe running around the outside.

Arrangements of this kind are in successful operation where the water is cooled from forty to fifty degrees with a loss by evaporation of about one-tenth of the entire volume of water passing through the condenser.

The different towers which have been described, as well as others of similar construction, are capable of the arrangement for variable loads, or of having several smaller towers rather than a single large

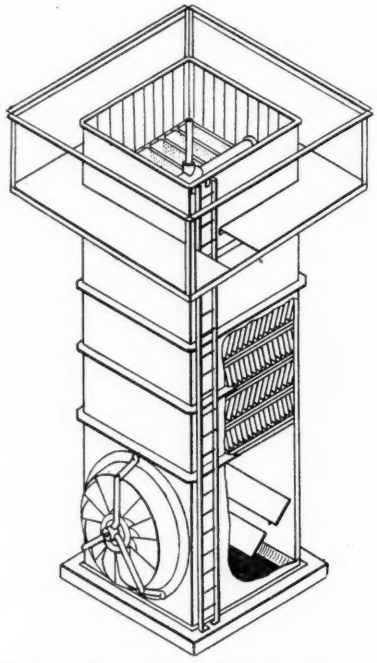


FIG. 4.—METAL PLATE TYPE OF COOLING TOWER.

one, so that as the load varies a greater or less number may be put into service or stopped, as the conditions may require.

The use of several smaller towers is preferable in cold weather on account of the cylinder oil from the engines which is liable to coagulate and clog up the

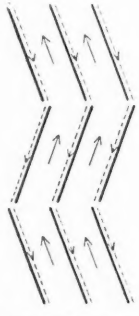


FIG. 5.—ARRANGEMENT OF PLATES IN COOLING TOWER.

cooling surfaces and interfere with the proper evaporation of the water.

This action is much less when the tower is operated at its full capacity. For this reason several units are desirable in order that the number used may be proportioned to the load, and it also gives an opportunity to clean those not in use.

In locating a cooling tower the matter of available space is the first consideration, although the question of piping must be kept in view. Where ground area is expensive, as in cities, roof installations are advisable.

Cooling towers may be used either with jet or surface condenser, but with the jet system an additional pump must be employed to deliver the discharge from the air-pump to the top of the tower.

The surface condenser is preferred when the tower is located on the roof, since the discharge and suction columns balance each other in this case as already stated, and so reduce the power necessary to raise the water to the tower.

When an additional pump is necessary for this purpose one of the centrifugal type is commonly used, since the steam consumption per horse-power is considerably less than for a reciprocating pump.

Growth of Cornell University.

The Cornell University (Ithaca, N. Y.) Register for 1907-1908 shows that the university continues its steady growth. The total number of students at this date is 4,640. This number includes those registered in the summer session and the short winter courses in agriculture. The number in regular courses is 3,635, an increase of 193 over last year, and of 250 over two years ago.

This gain in the total registration of the university has been pretty equally divided among its eight colleges. Especially significant is the increase in the College of Arts and Sciences from 747 last year and 705 two years ago to 791, for in view of the decline in the number of Arts students in many of our colleges such a growth could not have been expected. The largest increase, however, has been in the Sibley College of Mechanical and Electrical Engineering, where the enrollment is now 1,122 as against 1,081 last year. The instructing staff now numbers 507, an increase of twenty over last year, and of fifty-four over two years ago.

The material equipment of Cornell University continues to increase with the growth of the university. Last year saw the opening of the Rockefeller Hall of Physics, which, erected at a cost of $250,000, gives the university a laboratory that in commodiousness, convenience, and completeness of equipment can hardly be surpassed; and also of the beautiful Goldwin Smith Hall, the new home of the College of Arts and Sciences, completed at a cost of over $300,000.

This year marks the opening of the new buildings provided for the New York State College of Agriculture by the legislative appropriation in 1904 of $250,000.

A NEW UNIVERSAL PHOTOMETER.

BY PRESTON S. MILLAR.

In the study of illumination it is necessary to secure data on the following features of a lighting installation:

Light produced — candle-power or lumens.

Energy or fuel consumption.

Distribution of illumination.

The mere measurement of illumination intensity on some arbitrarily selected plane is insufficient to permit of intelligent conclusions. The full value of illumination tests can not be realized until the gross illuminating efficiency of ratio of illumination to energy is resolved into its component factors—lamp efficiency and proportion of light utilized. To accomplish this a photometer must be available for the measurement of candle-power as well as illumination intensity.

Recognizing these facts, Dr. Clayton H. Sharp and the writer have for the past three years devoted considerable time to the development of a photometer by means of which all features necessary to the complete study of a lighting installation could be investigated. First efforts in this direction served only to emphasize the importance of correct photometric design and of due regard to consideration of practicability and convenience in manipulation. Study of the requirements of the case, and increased experience in the conduct of tests of illumination have at last enabled us to arrive at an instrument which conforms with sufficient accuracy to the theoretical requirements and is at the same time entirely practicable.

DESCRIPTION.

A photograph of this instrument is shown in Fig. 1. The drawing in Fig. 2 illustrates its essential features and some details. The photometric device, B, is an adaptation of the Lummer-Brodhun photometer, possessing high sensitiveness, and avoiding distortion of color values through selective absorption or mixing of the two lights compared. One feature peculiar to this optical arrangement is its sensitiveness when working with very low luminous intensities as, for example, those encountered in street illumination.

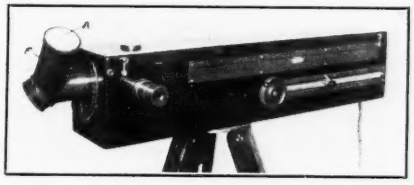


FIG. 1.—VIEW OF THE UNIVERSAL PHOTOMETER.

The character of the prisms which constitute the photometric device is illustrated in the lower left-hand part of Fig. 2. They consist of a simple Lummer-Brodhun cube to which is added an additional reflecting surface.

The standard comparison lamp is an electric incandescent lamp, C, which is moved along the photometric axis by turning the knob, O. This is a battery lamp of suitable characteristics when purposes of the test can best be served by a constant standard of light. When the instrument is to be used for measuring the candle-power or illumination of incandescent electric lamps where the line pressure is fluctuating, the comparison lamp is one which may be placed upon the lighting circuit, varying in candle-power with the lamps under test, and producing a state of photometric balance. Here the "similar-circuit" method of photometry is adopted.

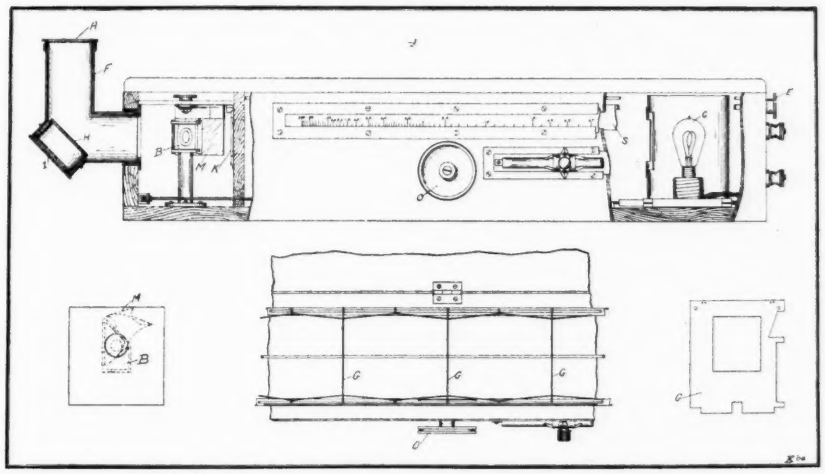


FIG. 2.—DRAWINGS SHOWING THE ESSENTIAL FEATURES OF THE UNIVERSAL PHOTOMETER.

The illumination produced on the photometric device by the comparison lamp varies precisely as the inverse of the square of the distance, conformity to the inverse square law being obtained by means of a specially devised system of screens, G, which automatically adjust themselves as the lamp is moved along the photometric axis, thereby protecting the photometric device from all stray light reflected from the interior of the photometer box.

The instrument is calibrated directly in foot-candles and candle-power, the scale ranging from 0.4 to twenty foot-candles. A pointer attached to the comparison lamp carriage plays along the surface of a translucent calibrated scale, which ordinarily is covered by a shutter, S. After a photometric balance is made, the shutter is opened by manipulating a milled head-screw, E, Fig. 2, and the scale in the immediate vicinity of the pointer is illuminated from the interior by the comparison lamp, permitting of easy observation of the result of the setting.

Attached to the photometer box is a rotating elbow tube, F. When the total illumination produced by light incident on a plane surface at any angle is to be measured, the end of this tube is equipped with a translucent plate, A, of carefully selected material, found by spectrophotometric test to be free from selective absorption and having a good diffusing surface. At the elbow of the tube is placed a forty-five-degree mirror, H. The lower surface of the translucent plate is viewed through the ocular tube, J, Fig. 1, through the prisms which constitute the photometric device, and through the forty-five-degree mirror at the elbow of the tube. Through the same ocular tube and prisms the translucent plate, K, illuminated by the comparison lamp, is viewed. A condition of photometric balance obtains when the illuminations of the two translucent plates, A and K, are found to be of equal intensity as observed in the contiguous fields of the photometric device.

When the instrument is to be used in measuring the candle-power of single-light sources, the translucent plate, A, is removed from the end of the elbow tube and is replaced by a screen having an aperture through which the direct rays from the light source may pass and fall upon a diffusely reflecting surface, I, which has been substituted for the forty-

five-degree mirror placed at the elbow of the tube when illumination intensity is to be measured. Photometric balance is then obtained by comparing the brightness of the diffusely reflecting plate, I, in the elbow of the tube with that of translucent plate, K, which is illuminated by the comparison lamp.

When it is desired to measure the intrinsic brightness of an illuminated surface as, for example, of the wall or ceiling of a room, the forty-five-degree mirror is placed in the elbow of the tube which is rotated about the photometric axis until it is directed toward the surface which is to be studied. The brightness of that surface is then compared directly to that of the translucent plate, K. In this way many studies can be made which add greatly to the value of an illumination investigation. Again, if it is desired to measure the illumination on the surface of a street, a diffusely reflecting surface may be placed upon the ground, and the rotating tube, equipped as last described, may be directed toward this diffusing surface from a point so located that the shadow of the instrument will not materially affect the results.

The range of the instrument is greatly increased by means of absorbing screens, M, of carefully selected material, so located that they may be placed either between the photometric device and the translucent plate, K, or between the photometric device and the rotating elbow tube. There are two of these screens, and they are so prepared that they absorb approximately ninety and ninety-nine per cent respectively of the light incident upon them. When the screens are placed in the photometric axis, which is accomplished by turning a milled head-screw, the scale indication of the instrument is either multiplied or divided by factors approximating ten and 100, respectively. The total range of the instrument is therefore approximately from 0.004 foot-candle to 2,000 foot-candles, with a given calibration and a single comparison lamp. If it is desired further to extend this range it is a simple matter to replace the comparison lamp with one having twice or one-half the intensity of that with which the previously mentioned range is covered.

UNIVERSALITY.

The instrument has been used with satisfactory results in work of the following character:

Measurement of candle-power of incandescent electric lamps in the laboratory.

Measurement of candle-power of arc lamps in the street and in the laboratory.

Measurement of candle-power of incandescent gas lamps in the street and in the laboratory.

Measurement of daylight illumination.

Measurement of interior illumination by electric incandescent and arc lamps.

Measurement of street illumination by electric and gas incandescent lamps and by arc lamps.

Measurement of intrinsic brightness and illuminated surfaces.

A rather unique field of usefulness would appear to exist for this instrument in that it has been found to work very satisfactorily in tests of the candle-power of gas lamps in the street. Having an electric incandescent candle-power standard, it yields results which are not affected by variations in atmospheric conditions. In gas lighting practice the candle-power of street lamps is generally determined by comparison with a flame standard which fluctuates more or less, as does the street lamp with atmospheric changes. Hence the true candle-power of the lamp is rarely determined, results obtained being shown in terms of the pentane lamp or of candles. With this instrument tests have been made in various cities to show the candle-power of the gas lamps in position. The operation is simple and the results are obtained in a short time.

The flexibility of the instrument is further attested by its successful use in the difficult problem of the determination of total-light flux from a Moore tube. Its thorough practicability renders it as suitable for the use of a central station in assorting returned lamps as in other more specialized work.

PRECISION.

The precision which is attained in work with the instrument is naturally dependent upon the photometric skill of the observer. Its capabilities as to precision are of the same order as those of a good laboratory photometer.

In measuring the candle-power of incandescent electric lamps, the instrument has been set up at the Electrical Testing Laboratories and the elbow tube has been directed so as to receive the direct rays of light from a rotating carbon-filament lamp on the bench of a standard photometer. Under these conditions typical results obtained by experienced observers in measurements of ten lamps, ranging from eight to thirty-two candle-power, show an average difference between photometers of from 0.8 to 1.5 per cent, with a maximum difference on any one lamp of from five to seven per cent.

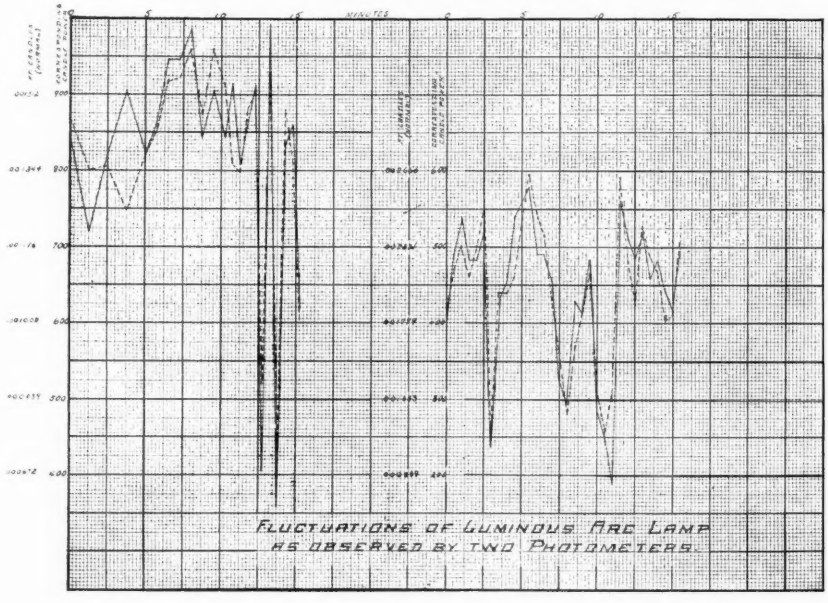


FIG. 3.—DIAGRAM ILLUSTRATING THE PRECISION OF THE UNIVERSAL PHOTOMETER.

Some idea of the precision of the instrument in work with low intensities is afforded by curves in Fig. 3. These show the fluctuations in light intensity of a "luminous arc" lamp, the tests being made at two different distances from the lamp. Two photometers of the type described were placed side by side with the elbow tubes directed at the lamp. Two observers endeavored to make simultaneous settings. This was very difficult because of the rapid light fluctuation, which necessitated "snap-shot" observations. Differences between the results obtained by two

observers and two photometers in this test are of course due more largely to the inability of the observers to effect settings at the same instant than to lack of sensibility of the instruments. The curves serve to illustrate, however, the means which the instrument affords of making a reliable, precise determination of the average value of an arc lamp during a given period of time.

A third illustration of the precision obtainable with the instrument is as follows:

In measuring illumination on a given plane of reference in an interior illuminated by incandescent electric lamps, it was found that there were excessive variations in the illumination intensity, due to changes in line pressure. Had the standard lamp been maintained constant it would have been necessary to extend observations over a sufficient period (often one hour or more) at each point investigated to secure a fair average value for the fluctuating intensity. As these fluctuations were found to cover a range of about fifteen per cent above and below the average value, this procedure was entirely impractical. Accordingly, the "similar-circuit" method of photometry was adopted and the comparison lamp was operated from the lighting circuit. Tests were made at ten points in the room, and after these were completed, repeated observations were made at some of the test stations. A comparison of the results so obtained follows:

Test Station No.	Results of First Observation. Ft.-C.	Second Observation. Ft.-C.	Per Cent Variation.
1	1.86	1.84	—1.1
2	2.03	2.09	+3.0
3	1.83	1.80	—1.6
4	1.78	1.81	+1.7
5	1.90	1.90	.....
6	1.84	1.90	+3.3
7	1.78	1.90	+6.7
8	1.73	1.71	—1.2
9	1.91	1.90	—0.5
10	1.76	1.74	—1.1
Average..	1.84	1.85	+0.9

In considering these figures, it will be observed that the average variation between the first and second observations amounts to 0.9 per cent, which is a very fair degree of accuracy for illumination measurements. It should be remembered that this difference is not alone one developed in repeated photometric settings, but may to some extent have been due to differences in the way in which the instrument was set up at a given test station, as the entire operation of setting up the instrument and making the photometric setting was repeated.

A photometer of this design works out well when reduced to the size of the model shown in Fig. 1. This is twenty-four inches long, four and one-half inches wide and five inches high, exclusive of the rotating tube, which, when the instrument is carried, is placed inside the box. The total weight of the instrument, completely equipped, is eight pounds.

Pittsburg Section of the American Institute of Electrical Engineers.

The Pittsburg section of the American Institute of Electrical Engineers met Wednesday, January 8, 1908, in the Carnegie Institute lecture hall, for a general discussion on "Illumination." One of the papers of the evening was given by Arthur J. Sweet, Westinghouse Lamp Company, of Newark, N. J. Mr. Sweet first reviewed the theoretical requirements for good illumination, classifying them under the following subjects: Efficiency of illumination, intrinsic brilliancy of light source, color, intensity, steadiness and efficiency of light distribution, size of illuminating source and the temperature to which it is possible to raise the incandescent solid when such is used. Visual perception is to be considered before candle-powers. The visual perception of an object lighted with an illumination of two foot-candles is very different when the field of vision is surrounded by intense light than when surrounded by a soft, weak light. In other words, light-reflecting walls should not be highly illuminated from a small, intense light source, but from a larger light source of lower intensity. Three, four, or five units as a light source give best results.

Kind of Lamp.	Mean Spherical Candle-Power.	Watts per Candle.	Candle-Power Hours per Kilowatt-Hour.
Common 56-watt carbon filament incandescent lamp, rated at 3.5 watts per candle, 16 horizontal candle-power	13.2	4.24	236
Common 50-watt carbon-filament incandescent lamp, rated at 3.1 watts per candle, 16 horizontal candle-power	13.2	3.78	264
Three-glower, 264-watt Nernst lamp	81.0	3.26	307
High-efficiency Gem, 125-watt, graphitized carbon-filament lamp of 50 horizontal candle-power	40.7	3.07	326
Forty-four-watt tantalum lamp, 22 rated horizontal candle-power	16.0	2.75	364
Direct-current 5.1-ampere enclosed arc on 110-volt circuit, 1.5-inch carbons	213.0	2.63	380
Alternating-current enclosed 5.7-ampere arc, taking 388 watts on 110-volt circuit, 0.5-inch carbons.	152.0	2.55	392
Sixty-watt, 110-volt tungsten filament lamp, burning at 1.25 watts per horizontal candle	37.0	1.62	617
Luminous 8-ampere arc, 440 watts, two in series, on 110-volt circuit.	1,020.0	0.431	2,320

Different colored papers absorb different amounts of light, and that which is absorbed is lost. The amounts of light reflected by different colored papers are: White paper, eighty per cent; orange paper, fifty per cent; yellow paper, forty per cent; light pink paper, thirty-five per cent; light blue paper, twenty-five per cent; emerald green paper, eighteen per cent; dark brown paper, ten per cent.

The above table compares the physical properties of the most common forms of electric lamps.

Mr. Sweet also said that the filaments of tungsten lamps are now spring-anchored and can be burned in any position. Samples of tungsten lamps were shown and the point brought out that a tungsten lamp can be burned at double voltage for over an hour without burning out, while a carbon-filament lamp would only last a few seconds.

G. M. Little, of the Westinghouse Electric and Manufacturing Company, gave a clear description of the art of making arc-lamp carbons from the time of the Jablochkoff candle down to the flaming arc and magnetite lamps, illustrating his talk with lantern slides. Arc lamps are now made with an efficiency of 0.2 watt per candle-power.

The manufacture of carbons has been gradually perfected in spite of many more difficulties than are generally known. Many different kinds of coke and mixtures of coke and lampblack were tried, analyzed, and refinements made, even down to extracting small quantities of iron impurities which made the carbons magnetic and blew the arc to one side.

George Loring, engineer of the National Electric Lamp Association, Cleveland, Ohio, gave an impromptu talk on the latest development of the tungsten lamp.

A letter was read from A. J. Wurts, who suggested that all lamps should have two ratings—a photometer rating and an illuminating power rating, the latter being based on the well-known sixteen-candle-power lamp as a unit.

Caribbean Wireless Stations.

Consul Drew Linard, of Ceiba, reports that the rumor that a series of wireless stations is to be erected at several ports on the Caribbean coast has been confirmed, and adds:

"The United Fruit Company has negotiated with the de Forest Wireless Telegraph Company for the establishment of stations at Belize, Puerto Barrios, Puerto Cortez and Ceiba, probably extending the system as far south as Port Limon, Costa Rica. It is assured that wireless communication between these points and the United States will be in operation by the first week in February.

"The United Fruit Company will serve the public, but subject to censure of all messages, retaining the privilege of refusing for transmission such messages as may appear prejudicial to its business interests."

HEUSLER'S MAGNETIC ALLOY.[1]

BY A. D. ROSS.

Since the discovery by Heusler in 1903 of a magnetic alloy of copper, manganese and aluminum, considerable interest has been aroused by the peculiarities of its properties and the difficulty of their explanation. In the summer of 1905 a preliminary investigation of a sample of the alloy was made in the physical laboratory of Glasgow University, and the results obtained have been published in a paper by Professor A. Gray.[2] The tests now described were carried out on an alloy with a somewhat lower percentage of copper, the composition being: Twenty-five per cent manganese, 12.5 per cent aluminum, a trace of lead and the remainder copper. The specimens were cast in the form of rings and rods by Messrs. Steven & Struthers, of Glasgow. So far only the rods have been used, the tests being made by the magnetometric method. In order to avoid any difficulty regarding the effective lengths of the specimens, elongated ellipsoids of revolution have been used instead of cylindrical rods. The factors investigated by Ewing have been employed to give the demagnetizing force due to the specimen and the true magnetizing field, H.

With a view to testing the apparatus, preliminary I-H cycles were taken with a rod of the alloy, about sixty centimetres long and 1.30 centimetres in diameter. It was tested in the condition as supplied by the makers, the casting being simply "dressed" and the ends cut square. A portion about one-third the length of the original rod was cut off and re-tested. On applying the corrections investigated by Du Bois, the two curves were in good agreement. The alloy exhibited very little hysteresis and the saturation point was well marked. A specimen, which had been ground on emery to an ellipsoidal form, was subjected to thermal treatment. After being taken through a cycle (Fig. 1, curve 1) it was heated for ten minutes to fifty degrees centigrade, slowly cooled and re-tested. No change in magnetic quality was observed. Successive heatings were then made to 100 degrees for a few minutes, to 100 degrees for two and one-half hours and to 145 degrees for a few minutes. In each case the specimen was slowly cooled and tested at the room temperature before proceeding to the next heating. So far the magnetic quality was little affected. The specimen was now baked at a temperature of 160 degrees for three days. This produced a distinct improvement in quality (Fig. 1, curve 2). The process of heating for short and long periods was continued step by step, and the magnetic quality showed gradual deterioration with a marked increase in hysteresis. Fig. 1, curve 3, shows the final

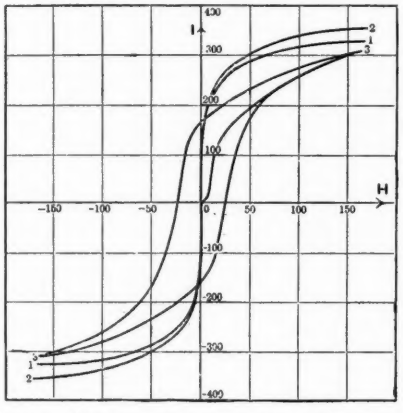


FIG. 1.—MAGNETIZATION CURVES OF HEUSLER ALLOY, SHOWING EFFECT OF HEATING.

state which was obtained after heating for two and one-half days to 220 degrees centigrade. In the heating up to and including 160 degrees a gas furnace was employed, but for prolonged heating at higher temperatures an electric oven was constructed and found to give very steady temperatures. In all the experiments the temperature was measured with a platinum and platinum-iridium thermometer. The series of heatings proved that the time effect is very large, especially in regard to the increase in hysteresis, and it was decided to reserve its further investigation until a special furnace could be constructed for this purpose.

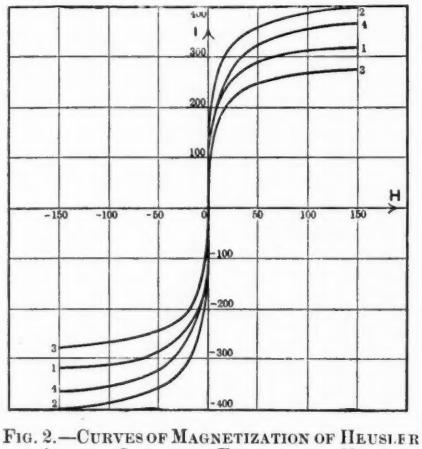


FIG. 2.—CURVES OF MAGNETIZATION OF HEUSLER ALLOY, SHOWING EFFECT OF HEATING AND QUENCHING.

Another ellipsoidal specimen was employed in an investigation of the permanent effects produced by bringing the alloy for a short time to a series of increasing temperatures and quenching thereat. But before this treatment was carried out the magnetic condition of the specimen was tested both while the temperature was that of liquid air and after the normal temperature had been resumed. The specimen was enclosed in a glass tube, which fitted into a cylinder of asbestos placed inside the magnetizing solenoid. One end of the glass tube was closed, the other was open and bent up so that the tube could be kept filled with liquid air. The curve (Fig. 2, curve 2) obtained when the specimen was thus cooled to 190 degrees centigrade showed an increase of about twenty-five per cent in the saturation value of I, but otherwise did not differ materially from that obtained at the room temperature (Fig. 2, curve 1).[1] On re-testing the specimen when it had warmed up to normal temperature it was found that the improvement had been only temporary.

The specimen was now heated to 400 degrees centigrade and quenched by plunging vertically into cold water. The magnetic quality was somewhat destroyed by this treatment and there was a decided diminution in hysteresis (Fig. 2, curve 3.) [With steel, nickel and cobalt similar effects have been obtained by the author, but in a diminishing ratio.] Immersion of the quenched alloy in liquid air produced a temporary increase of over thirty per cent in the saturation value of I, with a slight augmentation of the hysteresis (Fig. 2, curve 4). The specimen was laid aside for nearly ten months, and in this interval almost recovered its original susceptibility, while diminution in the hysteresis which had been effected by the quenching was only reversed to a very slight extent. The quenching tests were again resumed and cycles obtained for the following series of temperatures: 400, 450, 500, 555, 610, 660, 712 and 745 degrees. At each stage three tests were made: (1) with the quenched specimen, (2) with the specimen immersed in liquid air and (3) with the specimen back to atmospheric temperature. Fig. 3 exhibits the nature of the results obtained in this investigation. The abscissæ represent the temperatures of quenching, and the ordinates give the permeability corresponding to a field of twenty centimetre-gramme-second units for the specimen in the quenched condition. The lower curve

[1] From a paper read before the Royal Society of Edinburgh.

[2] Proc. Roy. Soc., Sec. A, 77, p. 266.

[1] The effect on the magnetometer due to the liquid air being magnetic was quite negligible.

shows the values obtained in the cycles at ordinary temperature; those obtained with the specimen in liquid air are shown in the upper curve. It will be noticed that there is a very marked diminution in permeability on quenching at 610 degrees, and on quenching at higher temperatures the quality is to a considerable degree restored.

Throughout the investigation there were traces of cracking in the specimen due to the quenching, and this would probably affect the magnetic tests to a slight extent. While being heated in the furnace preparatory to quenching at 800

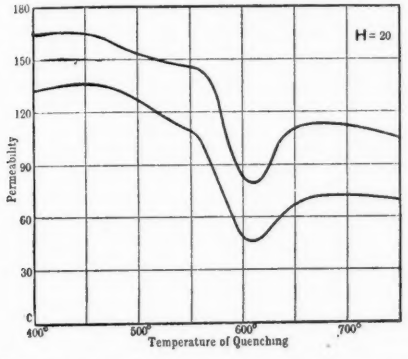


FIG. 3.—CURVES SHOWING THE EFFECT OF THE TEMPERATURE OF QUENCHING ON THE PERMEABILITY.

degrees, the specimen broke in two. An examination of the sections of fracture showed that a decided change in constitution had taken place. Originally fairly homogeneous, if we except the presence of a few small "blow-holes," the alloy now exhibited at least two constituents—large, irregular and lustrous nodules appearing embedded in the more uniform matrix. To such changes in structure we may probably ascribe the peculiar behavior on quenching at 610 degrees.

The Poulsen Wireless Telegraph Station at Cullercoats, England.

A description is given here of the Cullercoats station of the Amalgamated Radio-Telegraph Company, which is the only station in England using the Poulsen sending and receiving apparatus. The station is on the Northumberland coast, eight miles from Newcastle, and lies to the north of Tynemouth, and is in a convenient position for keeping in touch with the shipping on the North Sea. At this station both the de Forest spark apparatus and the Poulsen arc apparatus are employed; the former being installed in three rooms in the building, the latter requiring but one. The mast is of wood, 220 feet high, with the antenna spread out in umbrella shape over a circle of 200 feet in diameter. The antenna is divided into two sections, insulated from one another. The de Forest system is of the usual type, supplied with power from an eight-horse-power motor, which drives a five-kilowatt alternator. Current from this is transformed from 400 volts to 50,000 in a step-up transformer. The Poulsen equipment consists of two independent transmitting plants. One of these consists of three lamps connected in series and used for telephoning over short distances. This apparatus is used to demonstrate that the arrangement may be employed successfully for signaling over 500 miles. Each of the arc lamps works at 120 volts. The three in series are used on the 480-volt supply service. The copper and carbon electrodes are vertical, and the cooling of the copper anode, as well as of the arc box, is effected by radiating flanges exposed to the air. The striking of the arc is accomplished by lifting one electrode and allowing it to fall back to the adjusted distance. The box is kept full of hydrogen supplied from a gas cylinder or a calcium hydride generator, or alcohol vapor produced by allowing alcohol to drip into the chamber. Two pounds of hydride will provide enough hydrogen for sixty hours' continuous work. The carbon in these lamps is not rotated, but the arc is rotated by means of a vertical magnetic field. Normally, telegraphic work is carried out with a single copper-carbon arc. The copper and carbon electrodes pass horizontally through sleeves in the marble sides of the box. There is a fine adjustment for the copper electrode, but it can be pushed forward against a spring for striking the arc, and when released returns to its adjusted position. The arc is formed in a strong horizontal magnetic field perpendicular to it. The field-magnet windings are in series with the arc as well as a variable resistance. The current is maintained at about ten to twelve amperes. The box is kept filled with coal gas when the arc is in use. A woolly deposit of carbon forms on the poles of the magnet, which is probably due to the decomposition of the coal gas. In this particular arc box the carbon electrode is rotated by hand and the standard box is rotated continuously by clockwork. The oscillation circuit is arranged as a shunt to the arc and comprises an inductance of many turns of stout copper and a battery of oil condensers. The capacity is arranged in two sections so that, though a point of the inductance coil is put to earth, the outers of the public supply remain insulated. A variable condenser is kept in parallel with the fixed condenser. This enables changes in the wave-length to be made. The wave-length is usually between 1,200 and 1,500 metres. The coupling to the antenna is direct and loose. A hot-wire ammeter inserted permanently in the lead to the antenna gives a very visible record of the oscillatory current. When the arc is burning, the reading of this instrument is steady at nearly ten amperes. The sending key is an ordinary Morse key, which, in the rest position, short-circuits a few turns of the inductance coil. The pressing of the key in making dots and dashes thus changes the inductance in the shunt circuit, and, therefore, the wave-length of the oscillations, bringing the latter exactly to the magnitude required for affecting the distant tuned apparatus. This easy handling of the energy despatched into the antenna for radiation is one of the notable points of the Poulsen method. Though high-frequency currents of about 200,000 cycles a second and of the order of ten amperes are being dealt with, there is no spark at the sending-key contacts. The receiving apparatus is connected to the antenna in place of the sending apparatus by a small switch. The coupling to the antenna is electromagnetic and very loose. This is possible because with long trains of waves the effects of resonance can be made very marked; and is advantageous because the resonance curve of a circuit is the sharper and purer the slighter its ties to other circuits. Tuning is effected by a variable condenser in the resonant circuit. For perceiving the oscillations, Poulsen's "ticker" is employed. This is an electromagnetic trembler in which a very light, rapidly moving hammer closes and opens a branch circuit containing a condenser of larger capacity than in the resonant circuit. The result of the closing of the contact is that a great deal of the energy accumulated in the oscillating circuit passes into the condenser in the branch circuit and on the opening of the contact this discharges through the telephone. The contact points are best made of crossed gold wires, and the whole mechanism is enclosed in a small soundproof box. This device gives good readable signals from Danish stations, 360 miles distant. The system as installed presents no special insulation difficulties, and when in operation is perfectly silent, there being no loud noise which accompanies the use of the spark system.—*Electrician (London)*.

The Northwestern Electrical Association.

Sixteenth Annual Convention, Held at Milwaukee, Wis., January 15 and 16.

THE sixteenth annual meeting of the Northwestern Electrical Association was held at the Hotel Pfister, Milwaukee, Wis., January 15 and 16. Owing to the absence of President Daniels the convention was presided over by W. R. Putnam, manager of the Red Wing (Minn.) Gas Light and Power Company. In addition to the routine business the session on Wednesday morning was devoted to a discussion of the future policy of the Northwestern Electrical Association, and the advisability of affiliating with the Wisconsin Electric and Interurban Railway Association.

The matter of reporting to the Wisconsin Utilities Commission was discussed, and upon the motion of P. H. Korst, of Janesville, Wis., it was decided to appoint a committee to act in conjunction with a committee from the Wisconsin Electric and Interurban Railway Association in meeting the issue with the Utilities Commission. This committee includes C. N. Duffy, Milwaukee; R. N. Kimball, Kenosha, for the Northwestern Electrical Association, and P. H. Korst, Janesville; H. D. Smith, Appleton, and B. G. Broad, Sheboygan, for the Wisconsin Electric and Interurban Railway Association.

John S. Wright, of Antigo, Wis., raised the question as to the advisability of Wisconsin central stations surrendering long-term franchises and accepting the indeterminate permits provided by the new Wisconsin Utility Law.

B. L. Parker, of Green Bay, Wis., said that the immediate benefit to the central station would be in the elimination of unwholesome and unnecessary competition, permits would not be given to new companies while the existing company could supply the demand in a satisfactory manner. There was, however, a financial question involved, which put the matter in decidedly another light. This was the unwillingness of financiers to provide money for plants which would operate under an indefinite permit.

The afternoon session was called to order by Mr. Putnam at 2.30 o'clock. The first paper presented was entitled "Depreciation" and was read by the author, C. N. Duffy, controller of the Milwaukee Electric Railway and Light Company, Milwaukee, Wis. An abstract of Mr. Duffy's paper follows:

It is a difficult matter to lay down a fixed rule that will determine the measure of depreciation to be provided for and cover in a practical and satisfactory manner the differences in conditions and the various factors to be considered.

The different types of apparatus installed and the methods of construction and installation followed, as well as the varying conditions surrounding the operation of different systems, make the problem an exceedingly hard one to solve, even if confined only to providing for depreciation resulting from the effects of "deterioration" and "wear and tear," independent of "obsolescence" or "supersession."

The determination of the measure of depreciation necessary to be provided by reason of "deterioration" and "wear and tear," can possibly, with some degree of accuracy and satisfaction, be arrived at; the effects of obsolescence and supersession, practically unknown quantities, judging by the history of the past, present a most complex question of the greatest importance and most far reaching in its consequences.

Broadly speaking, the most correct and sound method to pursue would be to arrive at the estimated average life of the different kinds of physical property dealt with, determining this life on the basis of type, methods of construction and installation, as well as the character and extent of its use and the conditions under which it is used; climatic conditions, the character of the soil, as well as other similar factors, should be taken into consideration in arriving at this determination of average life. For example, the conditions of soil and climate would materially affect the life of pole lines, whether the poles were iron or wood, and likewise buildings, especially if of frame construction. Temperature and weather conditions have a direct bearing on the life of feeders, if exposed to the elements. The kind of water used for the generation of steam is an important element to be considered in determining the life of boiler tubes, and the same is true with reference to boiler furnaces, as to the effects of different kinds of coal burned. Conditions of operation with respect to the generation of electric current are reflected to a very considerable extent by the fluctuating load on the station as well as the average load-factor.

These varying conditions, as pointed out, should be taken into account in addition to the consideration of the question of types of apparatus, methods of construction and installation, etc., previously referred to.

The different kinds of physical property of an electric lighting system to be dealt with in considering "depreciation" may be broadly classified as follows:

1. Buildings and fixtures.
2. Generating station equipment.
3. Transmission system.
4. Substation equipment.
5. Distribution system.
6. Transformer installation.
7. Meter installation.
8. Lamp installation.
9. Tools and appliances.
10. Miscellaneous equipment.

The measure of "depreciation" to be provided for, as finally determined on the basis previously outlined and suggested, reduced to or expressed in dollars and cents, worked out in detail for each class of physical property, on the kilowatt-hour unit, should be taken up in the accounts monthly. This may be done, as a matter of detail, by one of the following methods:

1. "Operating expenses," in the appropriate accounts, should be debited and "depreciation reserve" credited, with the monthly proportion of the total annual "depreciation charge," based on the kilowatt-hour unit cost.

2. The monthly proportion of the total annual "depreciation charge," based on the kilowatt-hour unit cost, could be treated as a deduction from "net earnings from operation," and the amount so deducted credited to "depreciation reserve."

3. The monthly proportion of the total annual "depreciation charge," regardless of what the charge may be, based on the kilowatt-hour unit cost, could be treated as a deduction from "net earnings from operation," based on the percentage said charge bears to the estimated "gross earnings," for the year, and the amount so deducted, credited to "depreciation reserve."

If the "depreciation reserve" so created is to be something more than a mere "bookkeeping" reserve, and the amounts thus set aside actually invested in interest-bearing securities, the interest earned on such securities should be credited to "depreciation reserve."

It should be understood, of course, that when replacements and renewals of physical property are made, the cost should be charged against "depreciation reserve."

If the first method suggested is followed the "depreciation charge" introduced in "operating expenses" should be specifically stated and shown in the appropriate "operating expense accounts." If this is not done there will be no way of showing "ordinary maintenance charges" separate and distinct from "depreciation charges" and "operating expenses" will not clearly show actual results.

Unquestionably, the first method proposed is more scientific than the second or third, but the two latter will be found easier to work out and apply.

Either of the three suggested will accomplish the same results, in so far as ascertaining, on the same basis, what the "net income" is, applicable to "return on investment." The "measure of depreciation to be provided for" is the vital question; the methyd of its application, if sound and correct, is of secondary importance.

The Milwaukee Electric Railway and Light Company has, since January 1, 1898,

down to the present date, followed the third method suggested. John I. Beggs, president and general manager, is a pioneer in recognizing and providing for "depreciation." He not only had the wisdom and foresight ten years ago to recognize "depreciation," but the courage of his convictions in the administration of our property, to carry out the policy of providing for it in our accounts and finances.

In addition to providing for "depreciation," as previously defined and treated, provision should be made for a shrinkage in the value of the physical property if, through necessity, it is disposed of as junk or scrap at the expiration of limited-term franchises. The amortization of capital liabilities, for which there may be no tangible assets, should also be provided for, or sufficient "return on investment" be assured to justify capital assuming the risks attendant on the business.

"Depreciation" and "amortization" must be reckoned with in determining the cost of furnishing electric current, together with interest on investment, as well as the cost of generation and regeneration, the cost of distribution, the general expenses incident to the conduct of the business, and taxes. Indeed, to this cost should be added adequate charges to cover reserves for unliquidated damage claims and provision for contingencies, before the true cost of electric current, delivered to the consumer, can be fully and absolutely determined.

The subtraction of ordinary or current "operating expenses" and "taxes" from "gross earnings" does not represent "net earnings," available either for interest on bonds or dividends on stock.

A vote of thanks was tendered Mr. Duffy for his paper and it was discussed by Messrs. Jackson, Kimball, Korst and others. Mr. Jackson suggested a depreciation reserve of 2.9 to three per cent of the duplication value of the plant. Mr. Kimball asked whether the commission had up to date rendered an opinion upon the depreciation to be charged upon the various classes of service.

Mr. Duffy stated that the Utility Commission had absolutely gone on record in the case of the Merrill Railway Company as recognizing and demanding the application of the factor of depreciation.

The next paper was presented by Errett L. Callahan, of the General Electric Company, entitled "Central Station Load That Pays."

Mr. Callahan suggested the wider use of electrical devices in the home and said that the central station could supply seventy-five per cent of the additional power needed without increasing transformer, meter or plant capacity. Solicitors should be employed, preferably young lady solicitors, who could give demonstrations of the apparatus, and an attractive display made at the central station offices. Concerning the cost of cooking with electricity he stated that as a result of tests made recently he had arrived at a figure which showed a use of 264 watt-hours per person per meal, which, at five cents per kilowatt-hour, would cost 1.32 cents per person per meal.

This paper elicited considerable discussion, it being the consensus of opinion that the utilization of heating and cooking devices should be encouraged. Flat-irons were an exceptionally good proposition, and when once installed advertised themselves.

The next paper was presented by the author, W. R. Putnam, of Red Wing, Minn., entitled "The Debt of the Public to the Public Service Corporation." An abstract of this paper follows:

The public service corporation has been given its amount of attention in the legislative attempts at corporation regulation; its obligations to the public have all been prominently brought to the notice of the people without, however, in most instances, any attention being called to obligations that might be due the corporation. It would seem proper, at this time, to point out in what ways these corporations have benefited the people and what the people owe them in return.

Some of our public utilities have been in operation for a century, many for half a century, but the greater number have been serving the people less than a quarter of a century. The public, through its official representatives, has granted to organizations of capital permission to occupy portions of the streets of the municipality for the purpose of furnishing it and its inhabitants light, heat, power, water, the quick methods of communication and transportation. For the most part these franchises, when first given, were so granted because the people were as eager or more so to have the service as capital was willing to supply it. Such being the condition the larger portion of the franchises did not contain provisions which properly safeguarded the rights of either party interested; with the result that there has been almost constant wrangling between both parties involved over some or all of the questions of service, rates, taxes, and various rights covered by the franchise.

Meanwhile the communities supplied have been rapidly growing in population and oftentimes in area and the people's desire for all of these conveniences and necessities has even more rapidly grown: for the most part the franchise owner has kept pace with this growth by the investment of immense sums of money in both the manufacturing and distributing departments of his plant. At the same time he has been obliged to keep up with the rapid improvement of appliances by the replacing, oftentimes again and again, of obsolete machinery. This has been done, it is true, with the purpose of enhancing the value of the property and of securing a fair return on the investment; at the same time it has been done in response to the people's demand.

Now in what way have the franchise owners benefited the people in the operation of their plants? The last twenty-five years have been particularly conspicuous for a great change in the life of the American people; their tendencies are all more cosmopolitan, their knowledge has been more immensely broadened and their method of living has been greatly improved so that the conveniences of yesterday are the necessities of to-day.

It is not necessary to go into detail to show how immeasurably our products have aided in this transformation. Let us briefly allude to the street lights and the telephone as preventives of crime; to the immense saving of labor to the American housewife by the use of gas and electricity; to the relief from monotony and isolation brought by the present quick means of transportation and communication; and to the inestimable value of all classes of this service to the business man and to the manufacturer.

Unfortunately and possibly because of the apparent ease with which funds have been secured for the immense development of our plants, the public has become firmly convinced that, of necessity, there must be immense profits in our business; it has not studied the question thoroughly or it would have soon learned that, for every dollar we receive in gross earnings each year, we have from three to ten dollars invested in our business: in other words from twenty to fifty, or in some cases sixty, per cent of our total receipts, the amount depending upon the nature and condition of the particular kind of service, must be used to pay interest on our investment; that the majority of our investment is represented by bonds earning five or six per cent; that the United States Census returns show that the net earnings of all gas and electric plants in this country, before providing a depreciation fund and before paying interest charges, are only eight per cent on the capital invested; while the similar earnings of the street railway companies are only five per cent.

The public has taken it for granted that it has been unfairly and in some cases dishonestly dealt with by the owners of franchises, and now that it has wakened to the possibilities of regulation, it not only insists on a regulation which will give the public immensely cheaper service, but which will at the same time penalize the franchise owner for his unfair and dishonest acts of the past; wherever this unfairness and dishonesty have existed has not the public been as much to blame as the franchise owner, in that it has elected men to office who have been the means of this unfairness and dishonesty? The public service manager is human and if he ascertains that the only way he can secure legislation or even a permit necessary for the carrying on of his business is by dealing dishonestly with a dishonest representative of the people, too often, in the past, has he followed

the line of least resistance. Should not the people's fairness accede to eliminating entirely, from the subject of regulation, the question of penalty?

Again the public must awaken to the fact that the business management of the public service corporation is to-day more alive and more progressive than that of almost any other line of business. It is striving to increase its earnings per dollar of investment in every legitimate way and has used as one of the most potent factors in this effort, reduction in rates, even in the face of constantly increasing costs of labor and raw materials. The management, up to this time, has been well backed up by the corporation owner, who has advanced the necessary funds for the extensions and enlargements.

To-day, however, the conditions are different; the management is advised that it can have no more money for extensions. Why? Because, says the investor, we do not feel that your securities are safe; with the various attempts at rate regulation we are not assured of a reasonable return and consequently will invest our money where it is less liable to attack.

Therefore the public owes it to itself as well as to the corporations to consider this phase of the question, for with no extensions, how will its increased demands for service be taken care of?

The two largest associations of public utility corporations in this country have both gone on record as strongly in favor of reasonable regulation by the people. If the people will come to a realization of the immense good they derive from our service; will give us credit for new attempts to conduct our business honestly; will drop all ideas of penalty; will concede that our efforts to develop our business are entitled to a fair return; will drop the tendency to regulate rates by competition, and will approach the subject in a fair, conservative way, then, and only then, will regulation be secured which will establish, with the investor, the feeling of security necessary for the further enlargement of our business.

This paper was discussed at length by Messrs. Duffy, Lord, Utley and Parker. Mr. Lord said he thought the time had arrived when there could be straight, honest dealing between the municipalities and the corporations, and that in the new relations the corporations would witness a better day.

Neal Brown, of Wausau, Wis., delivered an interesting address on the functions of the Wisconsin Utility Law, which closed the afternoon session.

The Thursday morning session was devoted to the reading of two papers on small steam turbine plants, entitled "Steam Notes on a Turbine Plant," by J. L. Hecht, and "Electric Notes on Small Steam Turbine Plants," by C. W. Pen Dell.

On Thursday afternoon the first paper read was entitled "Electric Lighting in Cities and Villages of Three Thousand People and Under," by Irving P. Lord, general manager of the Waupaca Electric Light and Railway Company. An abstract of this paper follows:

Having been actively interested for some years in the electric lighting business in one of the small cities, and observing an increase of income from $6,000, the eighth year, to more than double that amount the sixteenth year, with no material increase in population, it convinces me that there are possibilities in the electric lighting field even in places of 3,000 population and under. These small plants are usually "one man" affairs and the owner is pretty nearly the "whole thing." At all events he is manager, bookkeeper, collector, auditor, solicitor and purchasing agent. He employs a practical, competent electrician, who with such help as is necessary, sees that the station is properly kept, and the general line-work and inside wiring satisfactorily done. If the owner is ordinarily capable, and keeps abreast of the times by regularly reading the electrical journals and attending his state association meetings, he will soon acquire such a knowledge of the business as it is quite necessary to have in order to make it a success. Another source from which the owner can get much practical knowledge is from the traveling salesman who will frequently honor him with a call. A more suave, better-informed class of gentlemen it has never been my pleasure to meet. They come in contact with many different propositions in their travels, and have perplexing questions presented to them almost daily, and it is no wonder they are often able to make suggestions that are valuable to the owner of a small plant, especially if he is new to the business. I, therefore, advise all such owners to cultivate the acquaintance and friendship of the traveling salesman representing reputable houses. Give them an order when you can, but give them the glad hand always.

A small owner should cultivate the soliciting habit. Assuming that his plant is in good physical condition he must then get the business. A reasonable rate for current should be established, and as to what is a reasonable rate local conditions will largely govern. Remember, however, it is always easier to reduce rates than to advance them. The acquaintance and the friendship of the merchants, manufacturers and others who might need considerable current should be cultivated. Pleasant argument with these men when they are not busy is productive of good results. Avoid technical terms when talking with them, and if you are selling current at ten cents per kilowatt-hour, say to them that a sixteen-candle-power lamp will consume approximately six-tenths of a cent's worth of electricity in an hour of time, and an eight-candle-power lamp a little more than one-half as much. Your prospective customers can better understand dollars and cents than they can watts, kilowatts, volts and amperes. Be persistent, but don't bore them. Never dispute their statements that illumination from kerosene oil or gasolene is cheaper than electricity, but convince them that it is not as good, or convenient, or healthful. If possible get them to try electric lighting for one year. It has been my experience that but a very small percentage will ever give it up.

Dwelling-house lighting is profitable, and is good business for a central station. The use of heating devices should be developed, and it is not difficult to do this. Flat-irons are especially desirable, and when installed at about cost will almost sell themselves after a thirty days' trial. They are usually consuming current when your load is the lightest, and the income they produce is practically clear gain.

Street lighting in small cities and villages is usually a perplexing feature of the business. The aldermen or board of trustees are seldom composed of the best business talent of the place. They have their own personal interests at stake more than those of the municipality they are supposed to serve. They think it quite the proper thing to be "against the electric light company" and they base their prospects of a reelection upon the vigor with which they have opposed the company and its business. Petty jealousies and personalities enter into their deliberations when acting upon an application of some citizens for a new street light, and it is often the case that no lamp is installed no matter how badly needed.

One thing that I find sadly lacking in the operation of small electric lighting plants is system. The business seems to be run too much on the country-store plan, which is really no plan at all. Very imperfect accounts are kept and the operation, construction and maintenance accounts are all so jumbled together that an expert accountant would have hard work untangling them. Many small owners have carried on their business for years without any definite knowledge at the end of the year as to just what the financial condition of the plant is. It is not necessary to have such a detailed system as many of the larger plants have, but it is absolutely necessary to have some perfect system. Almost any practical bookkeeper could soon devise one that would furnish the desired information at all times. A separate account should be kept with each customer, showing what his monthly bill is for current, supplies or labor. It is a source of satisfaction to the owner to compare these monthly accounts with those of previous years, and showing a prospective customer just what it has cost Mr. A. to light his store during the year just past will sometimes do much toward securing a new patron.

This paper was followed by a paper entitled "Single-Phase Alternating-Current Motors," by F. L. Kaufman. This paper provoked a spirited discussion, it being the consensus of opinion that the power company should give the customer reasonable time to prepare for a change, but to ad-

here strictly to its determination to discontinue the supply of direct-current to the consumer at the end of the stated period.

The question of whether the central station should do wiring and contracting was discussed by Messrs. Kimball, Putnam, Allen, Korst and Lukes. Generally speaking, the central station manager prefers to have all wiring handled by outside contractors. A point in favor of this is that each contractor is really a solicitor for the company.

C. J. Davidson, chief engineer of the Milwaukee Electric Railway and Light Company, addressed the meeting on the subject of coal consumption in small plants.

Upon receiving the report of the nominating committee, the following officers were declared elected for the season of 1908-1909:

President—P. H. Korst, Janesville.

First Vice-President—John S. Wright, Antigo.

Second Vice-President—J. S. Allen, Lake Geneva.

Secretary-Treasurer—R. N. Kimball.

Managers—J. H. Harding, La Porte, Ind.; P. E. Elevier, Superior; L. L. Tessier, De Pere.

The association discussed the matter of confining the membership to Wisconsin companies, but it developed that the membership was entirely opposed to the elimination of member companies from other states. A committee was appointed to confer with the Wisconsin Electric and Interurban Railway Association, with a view to holding a joint meeting next January.

The meeting adjourned and the majority of the members boarded the special train for Chicago, where, on Friday evening, the association was the guest of the Chicago section of the Illuminating Engineering Society.

The following is the register of attendance:

J. S. Allen, Lake Geneva, Wis.; H. P. Andrae, Milwaukee.

H. L. Bacon, New London, Wis.; Neal Brown, Wausau, Wis.

E. L. Callahan, General Electric Company, Chicago; N. C. Cotabish, manager National Carbon Company, Cleveland, Ohio; P. J. Cratty, Thos. H. Grier Company, Chicago, Ill.

C. J. Davidson, chief engineer, Milwaukee Electric Railway and Light Company, Milwaukee; J. R. Dishington, superintendent lighting, Milwaukee Electric Railway and Light Company, Racine, Wis.; C. N. Duffy, controller, Milwaukee Electric Railway and Light Company, Milwaukee.

P. E. Elevier, Superior, Wis.; M. C. Ewing, Wausau Street Railway Company, Wausau, Wis.

J. B. Griffith, Nernst Lamp Company.

J. H. Harding, manager, La Porte Electric Company, La Porte, Ind.; J. L. Hecht, North Shore Electric Company, Chicago; R. M. Howard, manager, Green Bay Traction Company, Green Bay, Wis.

Wm. B. Jackson, with D. C. & Wm. B. Jackson, consulting engineers, Chicago and Boston; F. N. Jewett, Chicago manager, Wagner Electric Manufacturing Company; M. H. Juhl, manager, Ashland Light, Power and Street Railway Company.

P. H. Korst, Janesville Electric Company, Janesville, Wis.; R. N. Kimball, secretary, Kenosha, Wis.; B. J. Kacin, salesman, Central Electric Company, Chicago; L. F. Kaufman, Beloit, Wis.; Ludwig Kemper, general manager, Albert Lea Light and Power Company, Albert Lea, Minn.; M. W. Knapstein, New London, Wis.

Irving P. Lord, secretary and general manager, Waupaca Electric Light and Railway Company, Waupaca, Wis.; Geo. H. Lukes, North Shore Electric Company, Chicago; B. F. Lyons, assistant general manager, Beloit Water, Gas and Electric Company, Beloit, Wis.

W. D. McDonald, Westinghouse Electric Company, Chicago; A. Meinema, M. B. Austin & Company, Chicago; Thomas R. Mercein, Milwaukee; F. W. Montgomery, Madison, Wis.

B. L. Parker, secretary, Green Bay Traction Company, Green Bay, Wis.; W. G. Patterson, manager, Menominee, Wis.; A. Paustian, Brillion, Wis.; C. W. Pen Dell, North Shore Electric Company, Chicago; Geo. M. Pierce, Brodhead Electric Company, Brodhead, Wis.; W. T. Pomeroy, manager and treasurer, Edgerton Electric Light Company, Edgerton, Wis.; W. R. Putnam, manager, Red Wing Gas, Light and Power Company.

O. M. Rau, manager, Electric Railway and Light Company, Milwaukee; N. Rowe, Kenosha, Wis.; T. T. Richards, Wagner Electric Manufacturing Company, St Louis; W. A. Russell, superintendent, Kenosha Electric Railway Company, Kenosha, Wis.

W. E. Smith, superintendent, Columbus Water Works and Street Railway Plant, Columbus, Wis.; H. C. Sterling, superintendent, Electric Light and Water Works, New London, Wis.; R. H. Strang, superintendent, Richland Center Light and Power Plant, Richland Center, Wis.; E. F. Strong, superintendent, City Light and Power Plant, Chaska, Minn.

L. L. Tessier, De Pere Electric Light and Power Company, De Pere, Wis.; Charles N. Thorpe, Chicago manager, Franklin Electric Manufacturing Company; John B. Tingley, General Electric Company, Madison, Wis.

P. L. Utley, Watertown, Wis.

W. H. Voth, Sheboygan, Wis.; B. D. Viles, Chippewa Falls Water Works and Lighting Company, Chippewa Falls, Wis.; O. L. Vogel, superintendent, Water and Light Plant, Fennimore, Wis.

Geo. S. Wheeler, Chippewa Valley Railway, Light and Power Company, Eau Claire, Wis.; C. W. Wilkins, National Carbon Company, Cleveland, Ohio; James Wolff, New York Insulated Wire Company, Chicago.

Meeting of the Chicago Section of the Illuminating Engineering Society.

The January meeting of the Chicago section of the Illuminating Engineering Society was held in the Coliseum Annex, Chicago, Ill., on Friday evening, January 17. Chairman George C. Keech presided. The subject of the evening was "The Gas and Electric Lighting of Apartments and Small Houses."

The discussion was opened by George H. Jones, of the Commonwealth Edison Company, who read a description of the electrical features of the "House Electrical" which his company had erected in the Coliseum to furnish to the public examples of electric lighting and the use of other electrical appliances. The "House Electrical" was located at the north end of the Coliseum, occupying all the space across the width of the building. A complete set of modern residence apartments arranged somewhat after the manner of a flat showed everything electrical which might be required for domestic comfort and convenience. The rooms included a vestibule and reception hall, a living room, dining room, butler's pantry, kitchen, laundry, bedroom, bathroom, sewing room and nursery.

Mr. Jones dwelt particularly upon the large number of outlets which had been placed at the disposal of the consumer, and suggested that in the matter of wiring a house of this nature economy was not so much desired as convenience and comfort.

Following the reading of the paper, the subject was discussed by Albert Scheible, E. W. Lloyd, W. R. Bonham, J. R. Cravath, G. H. Stickney, Ludwig Kemper, R. N. Kimball, J. M. Strasser, W. R. Putnam, C. A. Howe, H. von Holst, C. R. Gilman and others. Several members of the Northwestern Electrical Association which attended the meeting at the invitation of the Illuminating Engineering Society took part in the discussion.

Ludwig Kemper, of Albert Lea, Minn., said that while the "House Electrical" was a splendid example of a modern electrical installation, the fittings were too ornate and were not within the possibilities of the ordinary user of electricity in the small towns such as his central station represented. He inquired what might be the cost of installing an equipment such as would be possible for a town similar to his.

Mr. Jones stated that his company was making arrangements with its customers to wire the house complete and extend the period of payment over two years. He said that ordinarily the equipment would be as good as was represented in the "House Electrical," but that an installation could be made very much cheaper. He would estimate that ordinary wiring, using first-class fixtures, for an eight-room house would cost about $7.50 per outlet.

Mr. Scheible called attention to the departure which was now being made from the old-style gas fixtures, and said he thought that architects were giving a great deal more attention to the planning and installing of fixtures to be used exclusively for electrical service.

Mr. Strasser stated that the central station man usually did not have much say in the matter of laying out the illuminating scheme. The architect decided this for him. Even where the central station man, through his experience, might be able to offer good suggestions, it was only after other ideas had been discarded that he had his say. He stated, however, that the attention which is now being given to illuminating engineering had worked a very great change in the attitude of architects toward the laying out of the lighting schemes, and that a great improvement was apparent.

At the close of the discussion the nominating committee, through Albert Scheible, chairman, announced its report, which was unanimously accepted, as follows:

Chairman, J. R. Cravath.

Secretary, G. H. Jones.

Managers, H. von Holst and F. S. Pearson.

The Third Annual Electrical Show at Chicago.

THE third annual electrical show held under the auspices of the Electrical Trades Exposition Company, at the Coliseum, Chicago, Ill., from January 13 to 25, inclusive, was successful from every point of view. Not only was the representation of exhibitors larger than heretofore, but the attendance was as great and the inquiries elicited of much value to the manufacturers in attendance. From a spectacular point of view the show marks a new era in decorative lighting. Not only was there a lavish use of incandescent lamps for festooning and outlining, but by the use of decorative chandeliers the Coliseum was turned into a veritable fairyland. In the centre of the main exhibition hall there was suspended a huge canopy studded with incandescent lights. This canopy served the double purpose of a chandelier and support for festoons of bunting of various colors which were draped from the canopy eaves and caught up on the pillars surrounding the central floor space. As may be seen from the accompanying illustrations, there were eight centre chandeliers specially designed in papier-mâché, each equipped with 275 lamps, flanked on each side by forty-one-lamp chandeliers. In general lines the chandeliers were spherical and hemispherical. White and green lamps were used, and at each quadrant a red ball gave color and tone to the central fixtures. The entire scheme of decoration and the architectural features were worked out by D. H. Burnham & Company, of Chicago, under the direction of Manager Homer E. Niesz.

Throughout the two weeks of the show music was rendered each afternoon and evening by Weber's band, and on these occasions several vocal selections were rendered by Miss Florence Mehaffey.

The main floor of the Coliseum was entirely covered with exhibits of a general nature, and the Coliseum Annex was occupied by independent telephone manufacturers, who made a fine exhibit of the most modern apparatus for telephone service.

The manufacturers exhibiting, and their representatives, were as follows:

The American Automatic Telephone Company, Rochester, N. Y., exhibited a full line of automatic telephones, including its new harmonic ringer and new features in desk telephones and wall cabinets. The principal feature of this exhibit was a 1,250-line, two-wire automatic telephone system which was sold to the Home Telephone Company, of Bellevue, Ohio. The company was represented by C. L. Goodrum, William M. Bruce, Jr., and James S. Brailey, Jr., president of the company.

The American Clock Company, Chicago, Ill., made a fine exhibit of electric time systems, time stamps, time recorders and self-winding electric clocks. The company was represented by H. O. Jackson, G. F. Randall, secretary; H. W. Pidgeon, superintendent; R. B. Dick and P. J. Hertz.

The American Conduit Company, New York city, exhibited a line of conduit sections and photographs of typical installations. The company was represented by B. C. Groh and R. R. Macdonald.

The American Electric Fuse Company, Muskegon, Mich., exhibited a full line of its well-known products, including type H heat coil protectors, junction boxes, "Merico" soldering paste and cable compound, type L building terminal boxes, gas soldering irons, black enameled wire, station protectors, can-top terminals and the Allen-Bradley carbon resistance controllers. The company was represented by George W. Rodormer.

The American Electric Novelty and Manufacturing Company, Chicago, Ill., exhibited the "Ever Ready" dry battery, flashlights, pocket flashlights, clocks and other novelties. The company was represented by A. E. Barlow, general sales manager; P. E. Reiners, E. G. Weed, O. J. Igney and E. R. Behrend.

The American Electric Telephone Company, Chicago, Ill., made an extensive exhibit of switchboards, desk and wall telephones and specialties for telephone construction. The company was represented by P. C. Burns, president; J. G. Ihmsen, general manager; M. W. Zaben, sales manager; A. P. Ferdinand, sales engineer, and Alfred Landau.

The American Steel and Wire Company, Chicago, Ill., exhibited a full line of all kinds of wires and cables, rail joints and rail-bonding machinery, and a new screw hydraulic compressor. The company showed several novelties, including tempered steel springs 0.003 inch thick, and drawn wire 0.0025 inch thick. The company was represented by C. R. Sturdevant.

The Albert & J. M. Anderson Manufacturing Company, Boston, Mass., exhibited a full line of switches and line material. The company was represented by H. W. Hincher.

The Atlas Anchor Company, Cleveland, Ohio, showed a full set of anchors and setting tools and augers. The company was represented by I. Unger and C. E. Frost.

M. B. Austin & Company, Chicago, Ill., made a very attractive exhibit of specialties, including the Safety Insulated Wire and Cable Company's products, Benedict & Burnham Manufacturing Company's wire, Thomas & Betts outlet boxes, malleable-iron bushings and conduit fittings; Gillette-Vibber terminal heads, and G.-I. tungsten lamps. The company was represented by R. J. Thorne and A. Meinema.

The Automatic Electric Company, Chicago, Ill., made a striking exhibit of a cross-section of an automatic telephone system. This showed two interconnected common battery automatic exchanges of the 100,000-line type. One exchange section consisted of a standard 100-line unit and a board of trunking switches. This 100-line unit comprised 100 line switches and ten connectors, and in addition, a set of three rotary connectors used in connection with private branch exchanges. The second exchange section consisted of a regular party-line unit accommodating 100 party lines or 400 telephones and trunking switches. Twelve telephones were connected to the exhibit, and calls were made through the boards precisely the same as in the largest working exchanges. A toll board, wire chief's desk and private branch exchange were connected and operated in conjunction with the selector switches. A harmonic converter supplied four-frequency current for ringing party-line telephones. One of these frequencies was also used for straight-line ringing. In addition to ringing, the harmonic converter also furnished "busy" signals. The exhibit was in charge of H. H. Woodworth.

The Appleton Electric Company, Chicago, Ill., exhibited a full line of telephone supplies and wiring devices, and was represented by A. I. Appleton, treasurer and manager; Charles Appleton, superintendent, and John B. Painer, secretary.

B. S. Barnard & Company, Chicago, Ill., showed several sections of single and multiple duct. The company was represented by B. S. Barnard and E. F. Kirkpatrick.

The Bickley-Ralston Company, Chicago, Ill., made an interesting exhibit of "Phaunsteihl" coils, "Maximus" timers, spark plugs and meters.

The Benjamin Electric Manufacturing Company, Chicago, Ill., made a striking exhibit of its wireless clusters, connectors, swiveling attachment plugs, lamp guards and specialties. Of the new features which attracted a great deal of attention at the Benjamin exhibit was the separable wireless cluster. The company was represented by A. N. Fox, H. Watson and George Knott.

The Bristol Company, Waterbury, Ct., showed a full line of Bristol recording instruments for the steam, generating and transmission parts of electric light and power systems. There were also on exhibition a number of recording thermometers for feed-water, flue gases, superheated steam and recording gauges for steam pressure and vacuum, as well as stack draft. A full line of switchboard recording voltmeters, ammeters and wattmeters for direct and alternating current, single and polyphase circuits, was shown.

The new shunt recording ammeters recently produced were exhibited for the first time. There was also shown a complete line of portable recording voltmeters, ammeters and wattmeters. The company was represented by H. P. Dennis, western manager, and H. T. Carpenter, sales manager.

The C. F. Birtman Company, Chicago, Ill., made a very handsome exhibit of electrotherapeutic and X-ray apparatus and electro-massage vibrators. The company was represented by C. C. O'Neill, president; Horatio H. Harwood, secretary; Samuel C. Fogg and C. F. Birtman, mechanical engineer and designer.

The H. B. Camp Company, New York city, made an exhibit of single and multiple duct. A feature of this exhibit was the use of various colors of incandescent lamps at the far end of the ducts, so that the visitors could examine and become convinced of the smoothness of the bore of this type of vitrified conduit. The company was represented by its sales engineers and a corps of assistants.

The Central Telephone and Electric Company, Chicago, Ill., exhibited a fine line of telephones and telephone apparatus.

The Century Telephone Construction Company, Buffalo, N. Y., showed a full line of telephone specialties.

The Central Electric Company, Chicago, Ill., made a very attractive exhibit of its specialties, including "Okonite" wires and cables, "Okonite" and "Manson" tapes, "Columbia" tungsten lamps, G.-I. arc lamps, D & W fuses, Pittsburgh transformers and A. E. G. "Brilliant" flame arc lamps. The company was represented by George A. McKinlock, president; Charles E. Brown, secretary; F. R. Bryant, advertising manager; Allen S. Pearl, J. M. Lorenz and D. M. Ayers.

The Chicago Telephone Company, in conjunction with the American Telephone and Telegraph Company, made a fine exhibit, including full local telephone service with a six-position common battery switchboard, and long-distance telephone booths.

The Chicago Fuse Wire and Manufacturing Company, Chicago, Ill., showed five display boards, upon which were mounted "Union" enclosed fuses, enclosed fuse blocks, switch boxes, outlet conduit boxes and covers, and fuse wire and fuse links. The exhibit was in charge of A. S. Merrill, Clarence T. McDonald, George C. Reid and Walter D. Dana.

The Chicago Lamp and Reflector Company, Chicago, Ill., showed a line of art glass reflectors and shades for window illumination. The company was represented by William Block.

The Chicago Pneumatic Tool Company had one of the most interesting exhibits at the show. A full line of direct and alternating-current drills, grinders, hoists and blowers was shown in operation. There was also a new portable vacuum cleaning system for house and office use. The "Duntley" adding machine was also shown. The company was represented by C. B. Coates, Charles Hayes, J. H. Lamphear, Edward Aplin and James Boswell.

Frank B. Cook, Chicago, Ill., showed a full line of telephone protective devices and accessories, and was represented by Frank B. Cook and C. C. Newburn.

The Commonwealth Edison Company showed a nine-room residence fully equipped with electric portables, ceiling lights, wall brackets and heating and cooking devices. One of the interesting features in connection with the fittings used in this house was the "Autotherm,"

MAIN HALL OF THE COLISEUM, CHICAGO, ILL., ELECTRICAL SHOW OF THE ELECTRICAL TRADES EXPOSITION COMPANY, JANUARY 13-25.

designed and built by W. S. Heger, Jr. This device facilitates the use of electricity in cooking, as it is only necessary to bring the article to be cooked up to the cooking heat, when the current may be turned off and the utensil deposited in the "Autotherm," when the cooking process will be continued and completed, the utilization of insulating materials being so perfected that no heat transfer from the article is permissible to the outside atmosphere.

The S. H. Couch Company, Boston, Mass., made an exhibit of interior telephones, and was represented by Peter F. Hensel and S. H. Couch.

The Crane Company, Chicago, Ill., exhibited its steam and oil separators, and valves and fittings for power plants, made of cast-iron, ferro-steel and cast-steel. The exhibit was in charge of J. A. Minwegen.

The Crescent Company, Valparaiso, Ind., exhibited a full line of lamp guards, soldering compounds and frosting materials. The company was represented by J. H. McGill, manager.

The Colonial Art Glass Company, Chicago, Ill., made a beautiful display of domes, portables, fixtures and art glass specialties. These are designed from water colors executed by C. Eugene Parkhurst, the company's chief designer, who represented the company, assisted by E. C. Gmelin, R. F. Warner and B. P. George.

The Dean Electric Company, Elyria, Ohio, showed a full multiple section in operation, the Dean harmonic-ringer system, and a show-case comprising sample parts of the company's apparatus. The company also established a very attractive reception headquarters. It was represented by W. W. Dean, first vice-president; A. E. Barker, second vice-president; A. G. Bean, secretary-treasurer; R. H. Manson, engineer; S. A. Beyland, sales engineer; George A. Scoville, sales engineer; W. W. Kinsley, Jr., E. M. Ford, F. Coulson, A. B. Smith, R. Davis and W. H. Scott.

The Joseph Dixon Crucible Company, Jersey City, N. J., made its usual attractive display of crucibles, motor brushes and graphite lubricants. The company was represented by F. R. Brandon and B. B. Worley.

The Duplex Metals Company, New York city, showed a very interesting line of copper-clad wires and sheets. The company was represented by Avery P. Eckert.

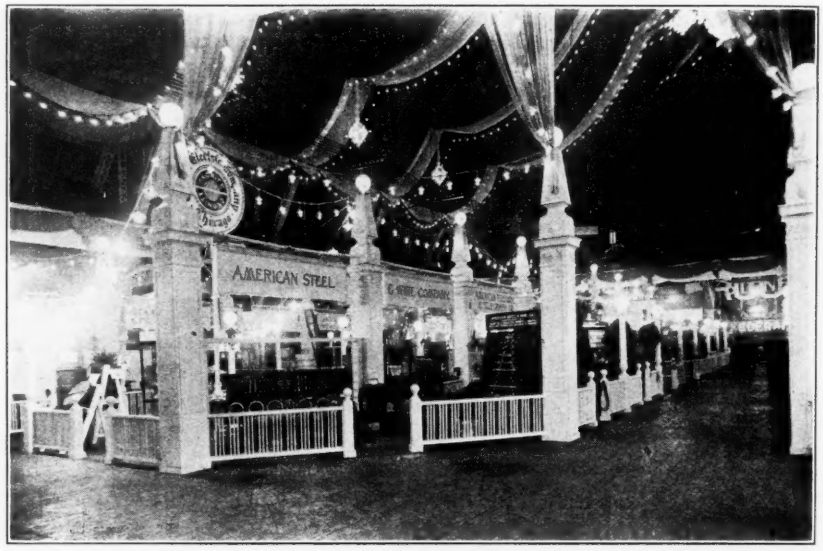
The Electric Appliance Company, Chicago, Ill., showed a very interesting display of "Sangamo" wattmeters, Packard tungsten lamps, Packard transformers, "Paranite" wires and cables, Couch & Seeley telephone apparatus, and "Faraday" and weatherproof bells. In addition to a corps of salesmen, the company was represented by P. R. Boole, R. S. Mitten and F. J. Alderson.

The Electric Sign Writer Company, Chicago, Ill., made a remarkable exhibit of a sign-writing device by which electric letters, numbers and the like were instantly formed and controlled by the operating of a standard keyboard typewriter attachment. This device was installed in the gallery at the north end of the Coliseum, and comprised three tiers, each tier containing twenty blocks, each block containing twenty-five incandescent lamps. The message is assembled by means of the typewriter keyboard attachment, and the connections transferred to a working bus, when the whole sign is flashed simultaneously. While this message is burning another message may be assembled on the keyboard typewriter attachment, and this, in turn, flashed simultaneously, when the first assembly returns the connections to their original condition, and the machine is ready for assembling another message. The company was represented by Leon I. Kahn, manager.

Arthur O. Einstein, Chicago, Ill., exhibited a number of specialties for which he is manufacturers' agent, including Pratt galvanized conduit outlet boxes and covers, "Trio" knife switches, Bonnell flexible conduit connectors and couplings, and Clifton rubber, gum, and friction tapes. Represented by Arthur O. Einstein.

The Electric Storage Battery Company, Philadelphia, Pa., exhibited a large line of storage battery material, the principal items being a G-51 chloride accumulator element in a tank of that size, having a capacity of 4,000 amperes; an F-21 accumulator element in a tank, and an F-15 accumulator element in a glass jar. There were also shown car-lighting batteries and "Exide" batteries for signal and vehicle service. The exhibit was in charge of Godfrey H. Atkin, Chicago office manager, assisted by J. M. S. Waring, district engineer, and Messrs. Bauer, Marshall and Rath.

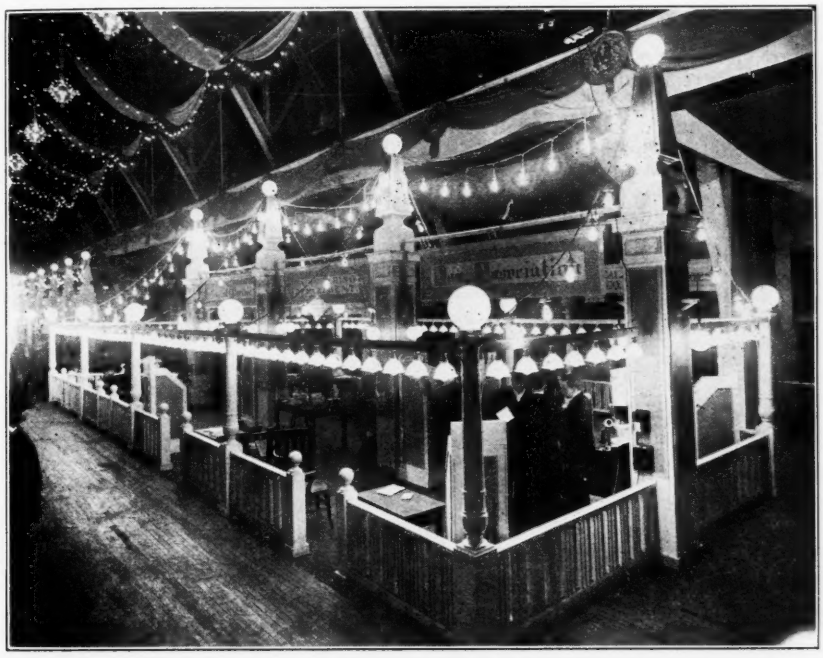
Erwin & Company, Chicago, Ill., exhibited a number of specialties, including



GENERAL VIEW, CHICAGO ELECTRICAL SHOW, COLISEUM, JANUARY 13-25.

GENERAL VIEW, CHICAGO ELECTRICAL SHOW, COLISEUM, JANUARY 13-25.

a bilge pump or seepage ejector, a two-stage centrifugal pump with compression tank, an Erwin automatic compression switch, a single-stage centrifugal pump for open house tanks, and an electric triplex pump. Represented by O. R. Erwin, Henry Erwin, J. A. Erwin and Wharton Clay.



General View, Chicago Electrical Show, Coliseum, January 13-25.

General View, Booth of the Chicago Fuse Wire and Manufacturing Company, Coliseum, January 13-25.

The Excelsior Supply Company, Chicago, Ill., showed an extensive line of electrical supplies and specialties.

The Electric Manufacturing Company, Chicago, Ill., showed the "M. & R." high-potential automatic cutouts.

The Federal Electric Company, Chicago, Ill., made a very extensive exhibit of unit electric signs, combination and decorative signs, and a new special couch light which has a number of special applications, and which attracted a great deal of attention. The company was represented by James M. Gilchrist, H. I. Markham, R. B. Francis, George Otis, L. G. Shepard, G. G. Beck, W. J. Devine, J. Kendrick, E. G. Tetu and T. J. Atkin.

The Fort Wayne Electric Works, Fort Wayne, Ind., showed a very interesting line of type H wattmeters, forms SAA and SAB, for single-phase circuits; form MAB for multiphase circuits; prepayment wattmeters, and the new type KM-1 calibrator for alternating currents. There were also shown the standard type A transformers, arc lamps for alternating and direct-current, series, multiple or power-circuit types, and a complete line of fan motors. The exhibit was in charge of W. S. Goll, Chicago office manager.

The Geen Electrical Manufacturing Company, Incorporated, Chicago, Ill., showed a number of electrical specialties.

The General Compressed Air and Vacuum Machinery Company, St. Louis, Mo., made a very striking exhibit, showing a portable wagon with a papier-mâché full-sized horse, representing the class C outfit for house-to-house cleaning by means of compressed air and the vacuum system. There were also shown portable apparatus for cleaning railway cars, factories, hospitals, and hand-bucket devices for office buildings, etc. The exhibit was in charge of Thomas F. Clohesey, sales manager, assisted by A. S. Foote, John M. Rodger, W. H. Averill, John A. Dunlap and D. Patrick.

The General Electric Company, Schenectady, N. Y., made one of the most elaborate exhibits at the show, occupying a space of over 700 square feet in the centre of the Coliseum. The exhibit was devoted principally to cooking and heating devices, among which were shown luminous radiators, coffee percolators, chafing dishes, water heaters, complete cooking and baking outfits, and flat-irons. These articles were shown in actual use, and visitors were served with electrically cooked delicacies in an elaborately furnished dining room. Another interesting feature of the exhibit was the color booth, in which color values were compared under various artificial lights, including the enclosed arc, incandescent, Nernst and Welsbach systems of lighting. There was also a large mutoscope showing views of the Schenectady, N. Y., works. One of the features which attracted a great deal of attention was a full-sized tile mantel equipped with a standard size bronze fireboard which was equipped with a specially arranged luminous radiator. This created a great deal of favorable comment from architects, contractors and central station men alike.

A. Grothwell, Chicago, Ill., showed a full line of "Mogul" insulating paints.

Dr. G. W. Haverstick, Chicago, Ill., showed an interesting application of the "Ocean Breeze" fans distributing humidified air.

Harter & Company, Chicago, Ill., made a demonstration of the Harter clusters with opal shades, and other specialties. The company was represented by G. A. Harter and C. J. P. Lucas.

The International Correspondence Schools, Scranton, Pa., made a moving exhibit, picturing the utility of taking up

the Correspondence School courses. Represented by B. H. Warren, C. E. Freelove, F. H. Tigue, W. M. George, Thomas Conroy, J. B. Kevan, C. C. Marson, B. H. Nymeyer and H. S. Hoover.

The International Telephone Manufacturing Company, Chicago, Ill., exhibited special loud-speaking telephones, local battery toll line instruments, central energy exchange telephones, multiple and trunking switchboards, self-restoring magneto drop switchboards and private plant intercommunicating equipments.

The Illinois Electric Renovator Sales Company, Chicago, Ill., showed an improved electric vacuum cleaning process.

The Jewell Electrical Instrument Company, Chicago, Ill., showed a line of fifteen different kinds of meters for alternating-current and direct-current service. A special feature was a small alternating-current "Baby" voltmeter and ammeter. There were also shown a new alternating-current rectifier, graphite resistances, and a special laboratory type of students' voltmeter. The company showed a combined voltmeter and ammeter with two ranges for each instrument, and a combination voltmeter and ammeter mounted upon a stand for students' use. Represented by Edward W. Jewell, Oscar Adleman and Ray Simpson.

The H. W. Johns-Manville Company, New York city, showed a line of "Victor" combination meters in both stationary and portable types, the "Linolite" system of lighting, by means of which the company's booth was illuminated; asbestos wood for switchboards, panel boards and fireproof barriers; "Noark" fuses and fuse devices, electric heating pads, friction tape, molded mica, and "Monarch," "Phœnix," "Vulcabeston" and "Electrobestos" insulations. The company was represented by H. M. Frantz, F. C. Frumveller, A. M. Chamberlin, A. M. Erskine, M. H. Crosswell, G. A. Saylor and W. F. Little.

The Kellogg Switchboard and Supply Company, Chicago, Ill., made a very effective exhibit of apparatus relating to all branches of telephony. There was also shown an oscillograph for illustrating the various wave-forms of pole-changers, magneto generators, voice currents, etc. The exhibit proper consisted of both common and local battery switchboards, telephones and pole-changers, railway telephones, wall cabinets and desk sets, and show-cases and display boards showing a complete line of small parts, such as relays, receivers, jacks, drops, etc. The company was represented by W. P. Booth, C. F. Winston, C. A. Simpson, L. J. Flint, G. A. Joy, G. B. Theiss, William Reid, A. L. Holstrom, L. R. Foote and C. G. Brady.

Mathias Klein & Sons, Chicago, Ill., showed a very attractive line of linemen's tools and electrical supplies. Represented by Alex J. Klein, John M. Klein, Jr., and Paul Herbst.

The J. Lang Electric Company, Chicago, Ill., exhibited an attractive line of switches, panel boards and switchboards. The particular feature of the exhibit was a new metering panel board showing the arrangement of the terminals in connection with a meter closet. The company was represented by R. S. Ripple, O. B. Duncan and L. Hawkinson.

The Lindstrom-Smith Company, Chicago, Ill., showed a very interesting display of "Red Cross" electric vibrators, and a new vibrating chair. Represented by C. O. Lindstrom and J. Mason Smith.

The Manhattan Electrical Supply Company, Chicago, Ill., showed a full line of electrical devices, including electric bells, dry batteries, flashlights and other specialties. Represented by A. R. Johnson, C. H. Methot, George Holly, A. Holland, T. L. Parker and William Haeger.

W. N. Matthews & Brother, St. Louis, Mo., showed a line of Stombaugh guy anchors, Hargis cable-splicing joints, Kearney cable clamps, Lima jack boxes and plugs, Callahan cable rollers, "Hold-Fast" lamp guards, "O. K." sleet cutters, "Easy" cord adjusters, lamp changers and bright reflectors. The exhibit was in charge of C. L. Matthews, assisted by Victor L. Crawford and Orville R. Johann.

The Moline Incandescent Lamp Company, Moline, Ill., showed a full line of its incandescent lamps, and was represented by Theodore Mueller, R. H. Mills and C. R. Wood.

The Monarch Electric and Wire Company, Chicago, Ill., showed a line of Monarch weatherproof wires and cables and galvanized strand, National India Rubber Company's rubber-covered wires and cables, lamp cord, packing-house cord, stage cable, Siemens and Nurnberg flaming arc lamps, "Radiant" arc lamps, Marquette arc lamps, Bryan-Marsh incandescent lamps, the Faries Manufacturing Company's portables, etc., and H. T. Paiste specialties. The company was represented by Louis A. Schwab, E. W. Kearns, H. E. Mason, E. J. Cassin, J. Morgan Hall, Henry Schwab and A. D. Gillespie.

The Monarch Telephone Manufacturing Company, Chicago, Ill., exhibited a switchboard and various types of telephones. Represented by E. E. Yaxley, J. C. Hubacher, W. H. Trimm, R. C. Stone, A. J. Carter, T. L. Dunlap and M. E. Hall.

The McDowell-Stocker Company, Chicago, Ill., showed a line of machine tools, riveters, power punches and lathes, all motor driven. These were equipped with Lincoln, General Electric, Western Electric and Northern motors. Represented by William J. McDowell.

The McRoy Clay Works, Brazil, Ind., showed a line of conduits in single and multiple duct. Represented by C. C. Baird.

The Moon Vibrator Company, Chicago, Ill., showed several forms of its electro-vibratory massage machines.

The National Electric Lamp Association, Cleveland, Ohio, made a notable display of forty and sixty-watt tungsten lamps. This exhibit covered a floor area of approximately 900 feet, and showed over 300 forty-watt tungsten lamps equipped with Holophane reflectors. Special features were installed for demonstrating the high quality of light delivered by the tungsten filament. The tungsten rays contain violet, indigo, blue, green, orange, yellow and red—in other words, all the colors of the sun; and the tungsten lamp is peculiarly efficient in those high-temperature colors lacking with the carbon-filament lamp. The quality of light was demonstrated by the use of several cabinets showing the effect of various illuminants upon colored fabrics, the effect of various color rays upon colored papers, the effect of various lamps upon a Newton disc, and the effect of different illuminants on various colored pictures. The exhibit was in charge of P. E. Norris, George Loring and A. W. Freund.

The Nungesser Electric Battery Company, Cleveland, Ohio, exhibited a reproduction six and one-half feet high and thirty inches in diameter of its well-known "1900" telephone battery. There was also shown a complete line of ignition batteries. The exhibit was in charge of Thomas G. Grier, general sales manager; H. S. Greene and H. G. Robbins.

F. W. Pardee, Chicago, Ill., showed a full line of the specialties made by the Rock Island Dry Battery Company, the Wire and Telephone Company of America, the Electrose Manufacturing Company, the Peru Electric Manufacturing Company and the Lippincott Glass Company.

The Phœnix Glass Company, New York city, made an elaborate display of portables, domes, fixtures and effects in art glassware. There was also a fine exhibit of the company's celebrated "Phœnix Quality" inner globes for enclosed arc lighting systems. The company was represented by E. H. Fox and C. E. Fricke.

The Radio Telephone Company, New York city, made a very attractive display of photographs showing typical applications of the de Forest Radio Telephone system as established on the battleships of the United States Navy. Dr. de Forest personally conducted the demonstrations from the company's booth at one end of the hall to the gallery at the other end of the exhibition building. Dunlap Smith president of the company, was in attendance, assisted by a corps of representatives.

The John A. Roebling's Sons Company, Trenton, N. J., exhibited a line of wires and cables of every description. Represented by A. B. Conover and H. G. Wilson.

Roth Brothers & Company, Chicago, Ill., showed a very attractive line of motor-driven blowers, exhausters, polishers, grinding lathes, and motors and generators. The company was represented by G. A. Roth, C. H. Roth, W. J. Warder, Jr., E. O. Benjamin, J. B. Kadic, William Roth and F. O. Creager.

The Robbins & Myers Company, Springfield, Ohio, showed a very handsome and effective line of fan motors and small motor applications adapted to sewing-machines, fan blowers and similar appliances. Represented by C. F. McGilvray, president and treasurer; H. A.

Porter, manager; O. F. Conklin, chief engineer, and W. J. Myers, secretary.

The Stolz Electrophone Company, Chicago, Ill., exhibited its "Electrophone" for enabling the deaf to hear. Represented by H. Stolz and Charles E. Viggars.

The Simplex Electric Heating Company, Cambridgeport, Mass., made a very elaborate display of cooking utensils and heating and domestic appliances.

The Simplex Electrical Company, Boston, Mass., made a fine display of insulated wires and cables.

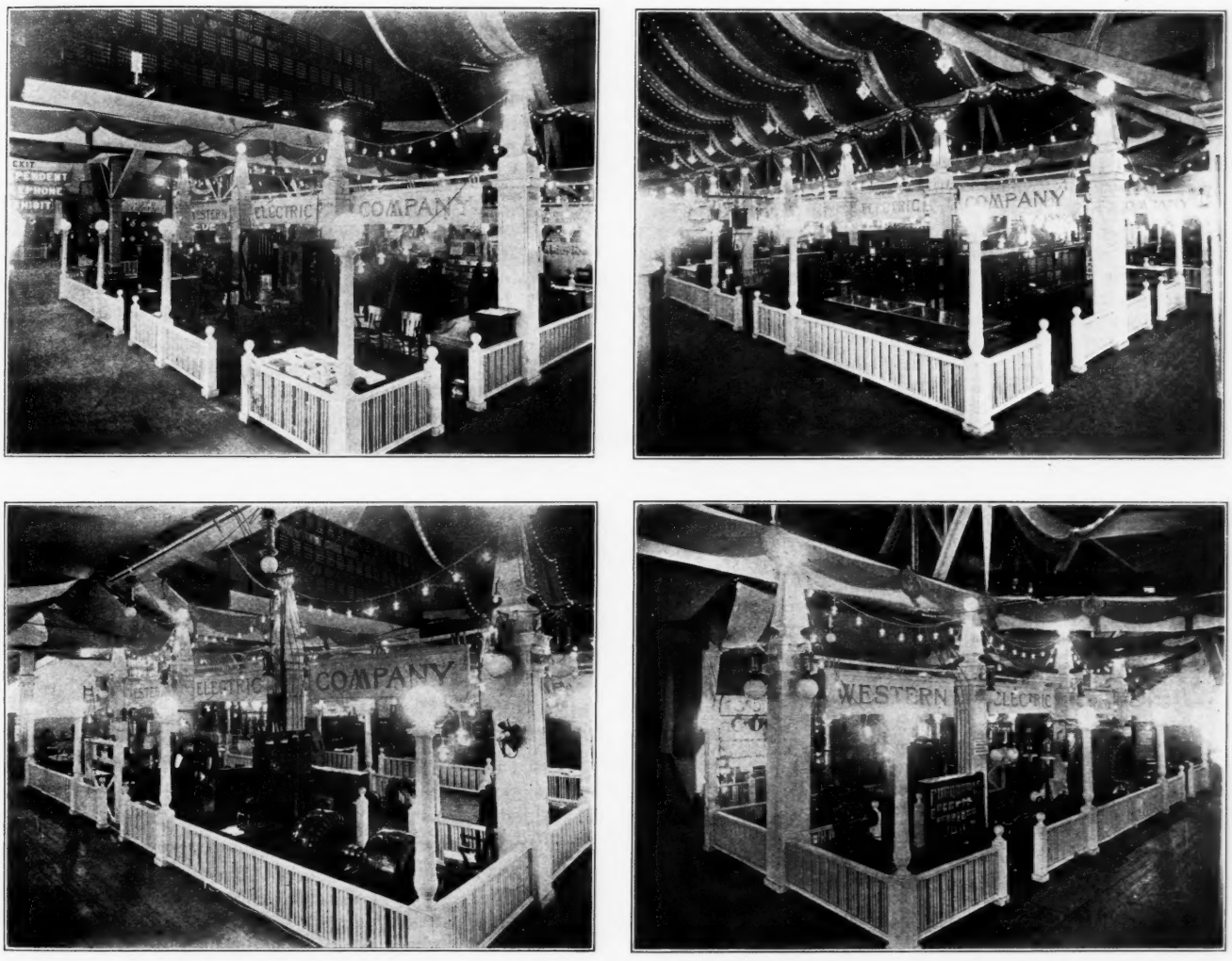
is a very effective device and attracted a great deal of attention from central station men and contractors present.

The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N.Y., exhibited a full line of telephone apparatus, including switchboards and telephones of various styles and designs. There was also exhibited a full line of cord products, magnet wire, aerial and underground cable. The company was represented by A. M. Haubrich, J. J. Nate, W. S. Robinson, H. J. Wilms, E. C. Lewis, A. O. Stigberg and C. Carlson.

victoria, stanhope and runabout, all equipped with "Exide" batteries. There was also exhibited a Westinghouse rectifier outfit demonstrating the charging of electric pleasure vehicles. The company has established a plan of regulating the facilities for electric charging, which is meeting with great success. Represented by F. S. Chapman.

The Staats Manufacturing Company, Chicago, Ill., exhibited its automatic holder for telephone receivers.

The Thordarson Electric Manufacturing Company, Chicago, Ill., made its usual



General Views of the Exhibit of the Western Electric Company, Chicago Electrical Show, Coliseum, January 13-25.

The Shelton Electric Company, Chicago, Ill., exhibited three model portable vibrators, an electrical hair-drier and other therapeutic machines. The company was represented by G. Shelton, president; A. J. Crowley, manager; J. M. Peacock, general sales manager; A. A. Grimes, Harvey Johnson and Rudolph Basse.

The Solar Electric Company, Chicago, Ill., exhibited a full line of "Canteen" illuminated lamp advertising devices.

The Spalding-Bates Manufacturing Company, Chicago, Ill., showed a new idea in incandescent lamp removers. This

The Swedish-American Telephone Company, Chicago, Ill., made a very fine display of switchboards, desk and portable telephones and intercommunicating systems and show-cases showing parts and accessories. Represented by E. B. Overshiner, president; A. V. Overshiner, secretary and general manager; J. W. Kulp and H. E. Jeffery.

The Swedish Electric Vibrator Company, Chicago, Ill., showed a line of new electro-vibratory machines. Represented by S. H. Finney and B. L. Finney.

The Studebaker Automobile Company, South Bend, Ind., exhibited an electric

attractive exhibit of high-grade high-potential electrical apparatus.

The United Clock Company, Chicago, Ill., made a very elaborate exhibit of electric clocks and time stamps.

The Universal Manufacturing Company, Chicago, Ill., exhibited panel boards and flat-rate controllers for central stations.

The United States Conduit and Construction Company, St. Louis, Mo., exhibited a new line of interlocking concrete conduit. This form of conduit is made upon the ground and eliminates manhole

sections if desired. The company was represented by C. D. Budd, president.

The Vivax Storage Battery Company, Chicago, Ill., showed a full line of sparking and vehicle batteries, a generator for recharging batteries, lighting and signal batteries, and a board showing the assembly of grids and plates, separators, terminals, etc. The exhibit was in charge of Horace W. Beck, assisted by Walter Aplin, Charles W. Hayes, Sidney Williams and Charles Wright.

The Vote-Berger Company, La Crosse, Wis., showed a complete section of its new ballast common battery telephones, magneto express switchboards, pendant telephones, guy anchors and adjusters for incandescent lamps. The company was represented by A. J. Schoephoester, P. W. Goodman, C. D. Enochs, J. N. Wallace and M. I. Berger.

The Wagner Electric Manufacturing Company, St. Louis, Mo., exhibited a five-horse-power, single-phase Wagner motor of the new BA type. This motor, while embodying the same principles of operation as the old-style Wagner motors, is in a new-style frame of modern design. There was also shown a ten-horse-power, three-phase induction motor and a new type of induction motor-starter for polyphase motors, as well as the "High-Efficiency" and "Standard Lighting" transformers. The company also showed a fine line of switchboard and portable indicating instruments, exhibiting some of the new designs which have been brought out during the past year. The exhibit was in charge of W. A. Layman, general manager; F. N. Jewett, Chicago district manager; C. B. Richardson, engineer; C. C. Warner, salesman, and Thomas T. Richards, advertising manager.

The Western Electric Company, Chicago, Ill., made a very elaborate exhibit, which was divided into two parts—a telephone exhibit and an apparatus and supply exhibit.

In the telephone exhibit a full line of magneto and common battery switchboards was displayed as well as all kinds of telephones, including local and common battery and intercommunicating sets. A self-restoring drop board was connected up and in full operation. In addition to the above a full line of standard construction material and cable terminals was shown. The power apparatus and supply exhibit was one of the most interesting exhibits to be seen.

The 400-kilowatt, sixty-cycle, three-phase, 2,300-volt alternator; the fifteen-kilowatt, 250-volt, direct-current, engine-type generator; a thirteen and one-half-volt, three-ampere ignition and battery charging generator; a direct-current, 250-volt motor direct-connected to a fifty-kilovolt-ampere, sixty-cycle, 440-volt alternator furnishing light for its booth and power to drive back-gear, continuous-service, phase-wound, vertical alternating-current motors, stators and rotors for squirrel-cage and phase-wound types of machines of various classes attracted constant attention. A five-light testing regulator that can be used for testing series alternating-current lamps during the day with a maximum voltage of 440, thus eliminating the danger to lamp repair men when using a larger regulator, was on exhibition and connected up so that the operation of the lamp and regulator was demonstrated. The new Western Electric 440-volt, multiple alternating-current lamp was shown and sample 110-volt alternating-current and direct-current lamps were included in the list of display lamps. This company has recently formed a selling arrangement whereby it becomes a distributor of the Beck flaming arc lamp and two of these lamps were on exhibition. An interesting feature of the supply exhibition was the new black enamel wire. A line of supplies manufactured or handled by the company was also shown, including American transformers, Vulcan heating apparatus, street railway material, "Electrose" insulating material, Thomas high-tension insulators, Duncan wattmeters, D & W fuses and "Deltabeston" wire. The entire exhibition was in charge of G. H. Lounsbery, assisted by the following gentlemen: J. H. Dutton, H. S. Kurtz, H. F. Boardman, R. C. Kearsley, A. R. McNally, P. Joyslin, W. P. Hoagland, W. W. Wise, M. R. Lash, H. D. Harding, F. H. Van Gorder, O. O. Tucker, H. W. Dye, T. W. Jackson, W. W. Templin, W. E. Meyers, F. A. Henderson, R. M. Hatfield, T. H. Delaney, D. C. Guest, W. H. Tompkins, George Cossman, H. A. French, J. Goettsch, B. H. Liskow, C. O. Ludlow, J. D. Edmonds, C. S. Boggs, S. York, W. R. Patton, H. A. Hoagland, W. H. Woods, H. W. Arnold, H. M. Post, A. M. Collins, T. H. Locke, A. R. Maynard, C. F. Alline, C. H. Macklin, P. G. Jones, H. B. Gilmore, H. E. Harkness, M. B. Minch, C. W. Holmes, J. T. Sweeney, J. W. Skindle, H. W. Sewall, E. C. Grant, H. T. Mitchell, C. L. Howk, T. R. George, C. H. Starkweather, Jr., J. H. Finley, E. M. Weir, E. Herbert, J. Danner, E. E. Hale, J. M. Hayes, A. T. Stewart, W. S. Taussig, H. E. Griffin and J. H. Gleason.

The Woods Motor Vehicle Company, Chicago, Ill., made a fine exhibit of Woods electric vehicles. Represented by Carl J. Metzer, sales manager.

There were in attendance a great many manufacturers' representatives well known in the electrical fraternity, who were either unattached or visiting their companies' exhibitions. Among these the following were noticed: F. H. Gale, A. D. Page, Errett L. Callahan, General Electric Company; N. C. Cotabish, C. W. Wilkins, National Carbon Company; E. H. Haughton, J. S. Corby, J. L. Barnard, George G. Lockwood, F. M. Henkel, F. W. Godfrey, Sam Furst, Bryan-Marsh Company; William Coale, A. M. Ryckoff, Sterling Electrical Manufacturing Company; Milton Hartman, Joseph H. Cooke, F. M. R. Evans, J. R. C. Long, Buckeye Electric Company; Arthur Jones, Arthur Jones Company; W. H. Sinks, Duncan Electric Manufacturing Company; Alexander H. Patterson, Phœnix Glass Company; Charles Howe, Holophane Company; Robert C. Lanphier, Sangamo Electric Company; S. E. Doane, chief engineer, National Electric Lamp Association; H. C. Rice, General Incandescent Lamp Company; E. J. Kulas and A. V. Hennecke, Brilliant Electric Company; George Cutter, George Cutter Company; R. L. Burton, Peru Electric Manufacturing Company; Philip R. Fisher, Condit Electrical Manufacturing Company; Julian Roe, Crocker-Wheeler Company; J. Robert Crouse, Cooperative Electrical Development Association; W. P. Clauson, Shelby Electric Company; W. R. Bonham, Westinghouse Electric and Manufacturing Company; J. P. Gillette, Gillette-Vibber Company; D. L. Markle, Mark Manufacturing Company; H. D. Kennedy, Sands Electric and Manufacturing Company; A. H. Cassidy, Charles W. Shonk Company; Syles R. Fralich, Syles R. Fralich Company; J. W. Phelps, Electro-Ad Company; E. L. Haines and A. D. Curtis, National X-Ray Reflector Company; William Low, Electric Appliance Company; George Searing, Hart & Hegeman Manufacturing Company; S. M. McFedries, J. L. Schureman Company; W. H. Gebhard; W. L. Fergus; Max Austrich, Felix Hamburger Company; J. R. Wiley, Standard Underground Cable Company; F. C. Maxheimer, Cooperative Electrical Development Association; H. B. Vanzwoll, Sunbeam Incandescent Lamp Company; L. L. Norman, Cleveland Switchboard Company; Hugh L. Adams, Electric Service Supplies Company; Edgar Switzer, W. E. Weinsheimer, the Weinsheimer Company; C. Wesley Taylor, Physicians' Supply Company; H. N. Powers, R. H. Watson, J. E. Widner, J. E. Eipper, Gould Storage Battery Company; W. W. Smythe, Jr., Fibre Conduit Company; Walter Doolittle, Sterling Electric Company; G. Stuart Hill, Trades Exposition Association, Limited; M. Lobenthal, Economical Electric Lamp Company; H. M. Vanzwoll, National Electric Lamp Association; C. A. Price, Sunbeam Incandescent Lamp Company; Dudley Farrand, president National Electric Light Association; Francis Raymond, Sheldon School of Correspondence; W. H. Jacobs, Triumph Electric Company; George C. Keech, Cooper Hewitt Electric Company; Edwin Irving, Sunbeam Incandescent Lamp Company, Limited, of Canada; C. N. Thorpe, Franklin Electric Manufacturing Company; J. H. Jackson, International Electric Meter Company; James Wolff, H. T. Paiste Company; P. J. Cratty, Thomas G. Grier Company; A. W. Biedler, president McRoy Clay Works; R. K. Mickey, Novelty Incandescent Lamp Company; Myer A. Loeb, Rock Island Battery Company; Joseph C. Belden, Belden Manufacturing Company.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Safety Apparatus for Broken Overhead Conductors.

A study is given here by P. Barré of the various schemes which have been proposed and tried for rendering broken overhead conductors harmless. The author divides these devices into eight groups: First, those which simply disconnect the broken wire by the mechanical opening of a switch due to the falling of the wire. The second group contains those devices which form a short-circuit when the wire is relieved of its normal strain and in this way open the circuit-breaker at the central station. The third group includes those devices which open the disconnecting switch mechanically, due to the breaking of a wire. In the fourth group he places those systems which cause a short-circuit whenever the main conductor breaks, and in this way open the circuit-breaker at the station. The fifth group contains those systems which are operated by an alternating current of high frequency which is superposed upon the main line, and which allows the circuit-breaker to open whenever this current is interrupted. In the sixth class are those devices which close a contact on an auxiliary circuit whenever the main wire falls thus opening the station circuit-breaker. In the seventh group are systems in which the feeding switch is kept closed by an electromagnet excited from the far end of the line, and which allows the circuit-breaker to open whenever the main wire is broken. In the eighth group are placed those systems which disconnect the main conductor whenever a telephone or telegraph wire comes in contact with it. The author believes that those systems comprised in the seventh group are the best for general conditions. The only difficulty is that the main switch is controlled by a current supplied from the far end of the main conductor. Where, however, there is a double track, the line may be cut up into sections, the two wires of each section being connected in series, thus bringing the point where the auxiliary wire is connected back to the disconnecting switch. In this design the coil is in circuit constantly; therefore, it must be designed with such resistance as to prevent excessive heating, and which will also allow for the usual changes in potential without opening the switch.—*Translated and abstracted from the Bulletin de la Société Internationale des Electriciens (Paris), December.*

The Wehnelt Cathode in a High Vacuum.

A description is given here by O. W. Richardson of some experiments which he conducted with a Wehnelt cathode. When Dr. Wehnelt first described his experiments, using a cathode covered with lime, the work had been done with small current densities only, and the results seemed to indicate that the current flowing was independent of the gas pressure in the tube. Some later work carried out by Frederick Soddy did not seem to be in agreement with Dr. Wehnelt's results, but in this case much larger currents were employed. Mr. Richardson points out that when these larger currents are passed through the tube a glow appears around the cathode, implying that the gas itself is being ionized and is playing a part in the conduction of the current. When the gas pressure falls so low that this glow can not be maintained a sudden drop in the value of the discharge current takes place. The author does not mean to say that the gas plays no part in the conduction under all conditions, but when the current density is small the leak of current from the cathode appears to be independent of the gas pressure at low pressures, and it seems unlikely that it is caused primarily by traces of any of the common gases, but is due to electrons thrown off by the cathode.—*Abstracted from Nature (London), January 2.*

Electrothermic Production of Iron and Steel.

In the concluding section of this study of electrothermic production of iron and steel, Dr. J. W. Richards draws some interesting conclusions from the experiments which have so far been made. The experiments made at Livet, France, showed that 0.34 ton of coke was used for each ton of pig iron produced, but there was a good deal of iron and manganese remaining in the slag. By raising the amount of coke to 0.41 ton there was still iron and manganese left in the slag. In the first case 0.226 electric horse-power was used for each ton of iron produced, and in the second, 0.475. These results indicate that by decreasing the amount of coke employed the necessary electrical energy should also be decreased. This is explained by the fact that when a smaller amount of coke is used a larger portion of this is burned to carbon dioxide, thus not only giving up more heat for each unit of carbon burned, but actually giving more total heat from the smaller weight of carbon than is produced when a larger amount of coke is used. The point to be recognized and kept in mind is that a given amount of iron reduced liberates a given quantity of oxygen. The oxygen set free from the amount of ore required to produce a ton of pig iron is about 0.4 ton. If this burns carbon only to carbon monoxide, it can burn 0.3 ton of carbon, and it then gives off only 729,000 calories. If, however, this oxygen is used to burn carbon to carbon dioxide, only 0.225 ton of carbon can be burned, but in doing this 972,000 calories are set free. Hence, the important conclusion is reached that the less the carbon employed in the electric furnace for reducing iron ore the more heat will be produced by the combustion of this, and the less electrical energy will be required for the reduction. This is, of course, within the limits of using enough carbon to give complete reduction. The keynote to economy in furnace reduction is the reduction of the carbon in the charge to the lowest possible minimum. Since this will coincide with the largest possible production of carbon dioxide in the furnace gases, an analysis of the escaping gases will give an idea of the condition of operation of the furnace. Dr. Richards concludes by saying that while the present types of furnace are imperfect, they give promise of great improvement in the future; that they are no more like the electrical furnace, which is shortly to be, than the old charcoal iron furnace is like the modern enormous blast furnace. There are two centuries of development between these two types of furnace, but he thinks that there will be not more than twenty years before the electric furnace has made similar progress.—*Abstracted from the Journal of the Franklin Institute (Philadelphia), January.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Gasolene-Electric Car for Railway Service.

The accompanying text and illustrations describe a gasolene-electric car which has been designed by the General Electric Company to meet railway service conditions.

The car is of the combination type, and comprises one ordinary passenger compartment, a smoking room, baggage room, engine room, toilet and observation compartment. The car is single-ended, having the controlling apparatus situated in the engine room. The length over all is fifty feet, the length of engine room nine feet six inches, and the seating capacity is forty-four. The total weight of car and trucks, fully equipped, is thirty-one tons. The shape of the ends is parabolic, to reduce the air resistance to a minimum when traveling at high speed. The general shape of the car will be seen by reference to the illustration, Fig. 1. The exterior of the car is of steel plate, while the interior is finished with selected Mexican mahogany. No wood is used in the engine compartment. The floors of the passenger and baggage compartments consist of two layers of wood with paper between, armored on the under side with steel plates. The under framing is of a very rigid construction. The centre sills consist of six-inch I-beams, and the outside sills are six-inch channels, and these are braced diagonally to lend greater rigidity. The car body was built by the Wason Manufacturing Company, Springfield, Mass.

The gasolene engine (Fig. 2), is direct-coupled to a ninety-kilowatt, direct-current generator, which furnishes current at a variable potential. This current is fed to the motors through the medium of the control system by which the voltage of the generator may be governed according to the requirements. The two motors are of the GE-72-A type, each rated at sixty horse-power.

The engine was designed and built by the General Electric Company with special reference to the requirements peculiar to gasolene-electric cars. When running at 550 revolutions per minute, it develops 100 horse-power, and has a greater capacity at increased speeds. There are eight cylinders, each of which is eight inches in diameter, and has a stroke of seven inches. The cylinders are placed at ninety degrees to one another, or at an angle of forty-five degrees to the vertical. Each cylinder is composed of one piece, being a casting of very soft fine-grain cast iron. Each casting is self-contained and includes the water jacket. All of the crank-pins lie in the same plane, the two centre pins occupying the same angular position, while the two outside crank-pins are set at 180 degrees to the centre crank-pins. This arrangement of cranks with cylinders set at ninety degrees to one another gives a very satisfactory system for balancing purposes. Two connecting rods are coupled to each crank-pin.

All of the valves, both admission and exhaust, are actuated by one cam-shaft which is driven from the main engine shaft by two gear-wheels with the customary two-to-one reduction.

There are two carbureters of the float-feed type. The ignition system is of the high-tension type; a separate coil is provided for each cylinder. These coils are energized by means of a small accumulator.

Considerable difficulty has been experienced in starting gasolene engines of this size heretofore, but in the present instance a special breech-block mechanism has been provided which fires a charge of black powder into one of the cylinders, and this has proved a most effectual way of overcoming these difficulties.

The cooling system for the cylinders operates on a thermo-siphon principle. The radiator, which is situated on the roof of the car, is divided into four separate nests of radiating tubes; these, being of the spiral-fin pattern, give a cooling surface of approximately 1,300 square feet. Each pair of engine cylinders is connected to one nest of tubes, and the four nests are in turn connected by means of three copper pipes.

The gasolene is stored beneath the car in a large steel tank, having a capacity of ninety gallons, and is raised to a small auxiliary tank in the cab by means of a diaphragm pump. The gasolene is filtered in transit from the tank to the pump. The auxiliary tank is provided with a float to register the height of the gasolene, and a glass tube somewhat similar to a sight-feed lubricator. The gasolene is fed by gravity to the carbureter.

Forced lubrication is used and for this purpose there is a nest of pumps operated from the main shaft. One pump is provided for each of the main bearings and another oils the cams and cam mechanisms, the duty of this latter pump being to keep the cam-shaft tunnel filled with oil; the oil on leaving the tunnel flows over the reduction gears and thence to the crank chamber. All of the oil used for lubricating purposes similarly flows to the crank chamber, from whence it can be drained. The big ends of the connecting rods are lubricated by scoops which dip into the oil in the bottom of the crank chamber.

The generator is a General Electric, ninety-kilowatt, eight-pole, separately excited unit, which has been specially designed with a view to procuring the lightest possible machine for the necessary output, and at the same time keeping the temperature rise reasonable. It is provid-

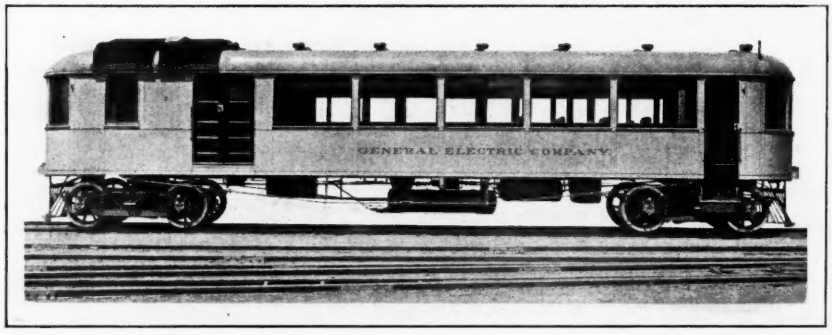


FIG. 1.—GENERAL ELECTRIC GASOLENE-ELECTRIC CAR.

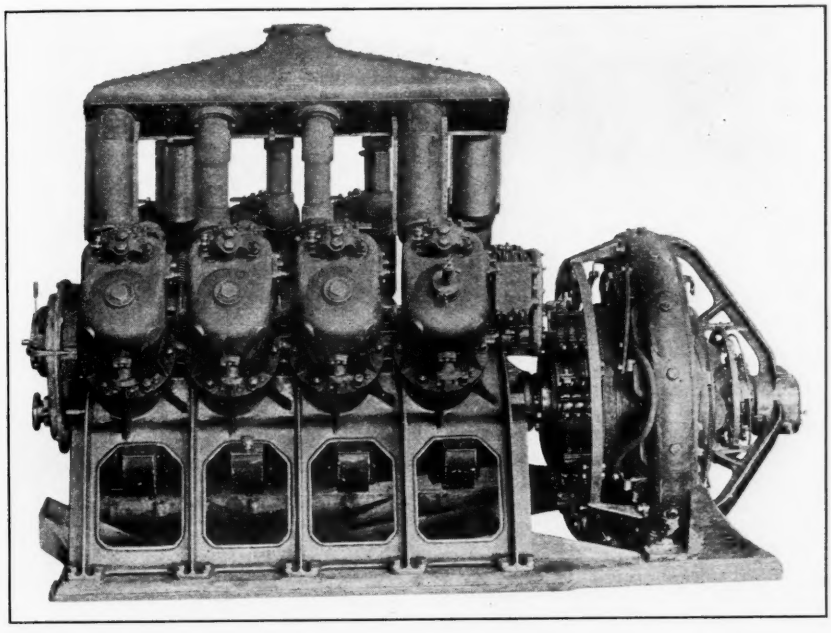
ed with commutating poles. The normal pressure when running at 550 revolutions per minute is 250 volts, at which time the current will amount to 360 amperes; but at starting a current of 800 amperes can be secured at a corresponding decrease in voltage.

The total weight of the generator, including exciter, is only 2,740 pounds, while a standard machine of this output weighs 8,800 pounds. As is only natural in a machine where the weight has been so materially reduced, the temperature rise is higher and the efficiency lower than in standard apparatus of the same output. The higher temperatures are fully provided for by the type of insulation employed. There is no paper or muslin used anywhere in the machine. The armature coils are insulated with mica, the interpolated pole coils with asbestos, and the field coils are wound with enameled wire. The armature leads to the commutator are riveted, as well as soldered, although the precaution has been taken to use pure tin for soldering, which has a melting point of over 200 degrees centigrade. Air ducts of ample dimensions are provided to insure a large volume of air being circulated through the core. The efficiency is eighty-eight per cent, being only about three per cent lower than a standard machine having a temperature rise of thirty-five degrees centigrade.

The exciter is a three-kilowatt, seventy-volt, shunt-wound machine, with its armature mounted directly on the armature shaft of the main generator and its field yoke supported by the bearing brackets, enabling it to fit under the back ends of the generator-armature windings.

The speed of the motor is governed by a potential control, the generator being separately excited and the terminal voltage of the motors being varied by means of a rheostat in series with the exciting circuit. The armature circuit of the main generator comprises the armature, fuse, two contactors in series, reverser, and the two motors. The motors are connected in series or in parallel, according to the position of the controller handle, and they are grounded to the truck framework, while the solenoid coils for operating the contactors are energized by a storage battery floating across the field circuit. The reverser is operated as usual by a separate reverser handle on the controller.

A storage battery which floats on the exciter circuit is used for supplying the lighting circuits, and its charging and discharging is controlled by means of a reverse-current relay which permits the lamps to be supplied directly from the exciting circuit or from the storage battery, according to the voltage of the exciter circuit. A Tirrill regulator is employed for regulating the voltage on the lighting circuit. These arrangements enable the car lamps being used when the engine is at rest.



GASOLENE MOTOR DIRECT-CONNECTED TO NINETY-KILOWATT, DIRECT-CURRENT GENERATOR.

The master controller, which has some unique features, is of type C-44, and gives seven steps with the two motors connected in series, and eight steps with the two motors connected in parallel. It is provided with four handles, three of which are mounted one above the other on concentric shafts. The function of the top handle is to advance and retard the ignition of the engine, the second controls the throttle of the engine, while the third handle controls the generator field resistances and the contactors, which establish the circuit for the motors, besides transposing the motor connections from series to parallel. The fourth handle operates the reversing switch and controls the direction of rotation of the motors.

The car is heated by passing part of the exhaust gases through pipes suitably located in the car body.

The car is provided with a straight air-brake equipment and the air is supplied by means of a compressor which is direct-connected to the engine. Hand brakes are also provided.

The trucks were constructed by the American Locomotive Company. They are of the swing-bolster type, and have wheels thirty-six inches in diameter. One motor is mounted on each truck.

The interior of these cars can be designed to suit any requirements or service. Cars of this type are available for use as private cars, with sleeping and dining accommodations; as inspection cars, wrecking cars, and baggage cars, etc.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on February 4, for the following electrical supplies: 14,000 feet braided rubber-covered conductor, for delivery at Puget Sound, Wash.; 1,350 miscellaneous fuses, 150 pounds cut and uncut mica, 150 pounds micanite plate, miscellaneous spare parts for Lundell desk fans, for delivery at Mare Island, Cal.; 1,000 pounds annunciator wire, 500 yards flexible silk-covered lamp cord, miscellaneous electrical supplies, one resistance box and Wheatstone bridge, 2,700 pounds miscellaneous copper wire and three induction motors, for delivery at New Orleans, La.; seventy-seven recording wattmeters, for delivery at Annapolis, Md.

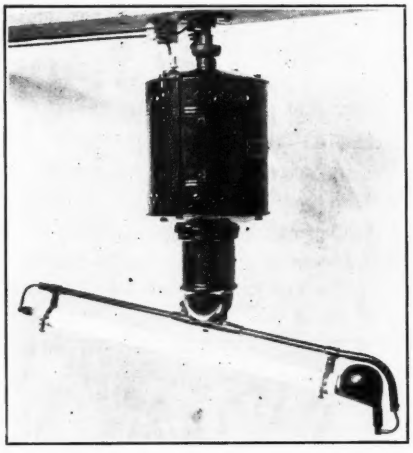
New Model of the Cooper Hewitt Lamp.

The 1908 model of the Cooper Hewitt lamp has a number of improvements which add much to the commercial value of the lamp, as in it have been incorporated several mechanical and electrical improvements as a result of the experience gained during the last five years.

The general form of the tubes of the several types of lamp remains the same, together with the quality and the high efficiency as a producer of light. The improvements which have been made are for the most part in the auxiliary apparatus and the method of installation. The new design makes it possible to handle each lamp outfit as a unit, and has simplified the hanging of the lamp. The changes have been improvements in the method of manufacture and in the assembling of the auxiliary apparatus. The new casing of this apparatus resembles the housing of an arc lamp, being cylindrical in form, as shown in Fig. 1, and about eight inches in diameter and ten inches high, with the supply wires entering binding-posts at the top. The cover is hinged and may be thrown back, furnishing ready access to the parts of the apparatus. The lamp rod which supports the lamp tube is attached directly to the auxiliary by a pivot screw.

The hanging and connecting of the new lamp is extremely simple. A ceiling plate, a short threaded pipe nipple, and an insulating joint are furnished with each lamp outfit. These are fastened to the ceiling, and the auxiliary is screwed to the insulating joint. Where it is necessary to hang the lamp at some distance from the ceiling, a pipe or conduit of the proper length may be used between the plate and the auxiliary. Where lamps are hung from outlet boxes, the ceiling plate may be dispensed with. When desired, the lamp may be hung from a wire rope by screwing a hook to the insulating joint and properly guying the lamp so that it will not swing.

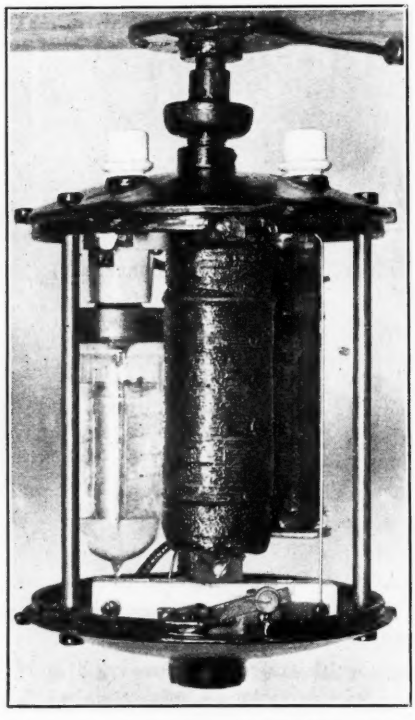
The performance of the mercury-vapor lamp depends directly upon the auxiliary apparatus. In the new auxiliary the number of parts has been reduced, and the design and manufacture of them improved. The new parts are readily replaced or repaired. The ballast, or adjuster, is made with a standard plug base, and screwed into an Edison socket. The inductance coils are thoroughly insulated, and the resistance is entirely embedded in an enameled-coated spool which protects the wire against the deteriorating effects of gases and dampness. The resistance spool has two binding-posts so that the lamp may be adjusted to the actual voltage of the supply. All standard Cooper Hewitt lamps are made for



1908 Model, Type H, Cooper Hewitt Mercury Vapor Lamp.

either 110 or 220 volts; the resistance spool furnishes what little adjustment is necessary in the particular group for which the lamp is intended.

Close regulation of the supply voltage is not necessary to the successful perform-



Auxiliary Apparatus, Casing Removed.

ance of the lamp, as the ballast and the inductance coil compensate for ordinary fluctuations. Standard series lamps are operating satisfactorily on power circuits of 500 to 600 volts.

Steam Turbine and Generator for Washington Paper Mill.

After installing an electric generating unit and operating a portion of its plant with motor drive, the Everett Pulp and Paper Company, proprietor of a large mill at Everett, Wash., noted for the quality of its output, recently decided that the economies effected by this system, as well as numerous other advantages, warranted it in putting the entire plant on the same basis.

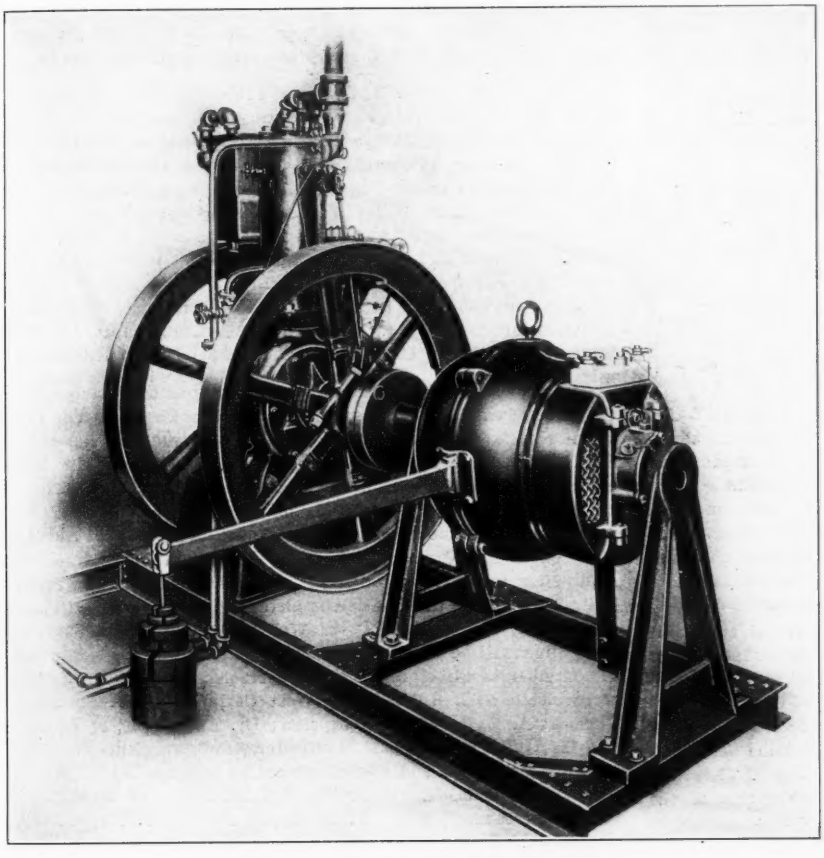
Accordingly the president and general manager of the company, W. H. Howarth, on his return from an extensive trip abroad, visited the leading industrial centres of the East, accompanied by T. H. McDonald, his chief engineer, with a view of deciding upon the best type of prime mover to use; and, after observing the operation of various standard machines, particularly in the light of his European experience, Mr. Howarth concluded to purchase a steam turbine, having 500 kilowatts' capacity, of the improved type built by the Allis-Chalmers Company. During Mr. Howarth's investigation, which included the inspection of numerous installations of these units, as well as a visit to the shops at West Allis, near Milwaukee, where many turbines in various stages of construction were carefully examined, the question most thoroughly gone into by Mr. Howarth was that of "reliability," Mr. Howarth having some doubt as to whether the steam turbine could be sufficiently depended upon as a prime mover for the service required in his company's mill. The builder was able, however, to point to a large number of its turbines installed not only in electrical railway and lighting plants, but also in industrial works of various kinds, ranging from factories where the load is comparatively uniform and steady to steel mills where it fluctuates widely and with great rapidity during continuous twenty-four-hour operation; and the results demonstrated were such as to leave no doubt in Mr. Howarth's mind as to the dependence to be placed on these units even under the most severe conditions of service.

A Correction.

In the issue of the Electrical Review for January 11, on page 77, an error occurred in the matter descriptive of the J. L. Schureman Company, Chicago, Ill. It was there stated that the company had its origin in the year 1903. This should have read "1893," making the company fifteen years old instead of five. The date of incorporation, which was given as 1901, should have been 1904.

An Electric Dynamometer.

A dynamometer of the electric-absorption type, manufactured by the Sprague Electric Company, 527 West Thirty-fourth street, New York city, is shown in the accompanying illustration. In the ELECTRICAL REVIEW for September 7, 1907, a description was given of this type of dynamometer as constructed in sizes of from ten to 100 horse-power. The dynamometer shown herewith is constructed for testing engines varying in size from one to ten horse-power. The principle of operation is, however, the same as that of the larger apparatus.



THE SPRAGUE ELECTRIC DYNAMOMETER.

These dynamometers are intended for giving instantaneous values of the brake horse-power of any engine, motor, pump, or other tool which may be placed upon the testing frame. The principle made use of is the magnetic reaction set up between the armature and fields of a dynamo. The machine to be tested is lined up with the armature-shaft of the generator and attached thereto, and when set in motion drives the armature in the usual way. The generator frame is carried on trunnions mounted in ball bearings, which allow the field magnets to move concentrically with the armature. The reaction set up when the latter is delivering current tends to drag the field frame around in the same direction of rotation, but this drag is balanced by means of weights placed on an arm bolted to the field frame. The load is varied by varying the output of the generator, which may be done by varying the absorbing resistance or by adjusting the field excitation. When a balance is secured the weight on the lever arm is noted, the speed of the engine is observed, and a calibration curve gives immediately, without any calculation, the horse-power output of the engine. This operation is so simple that any mechanic may conduct the tests accurately and without difficulty.

The dynamometer may be used for observing instantaneous values of the output of the engine or for operating the latter for a running test, the design of the generator being such that it will deliver ten horse-power continuously without excessive heating. When such a test is being conducted the output of the dynamometer may, if thought desirable, be delivered to the lighting or power circuits of the shop where the test is being conducted, thus saving the energy which would otherwise be lost.

Electrical Oscillations on Helices.

It is usually assumed that when electrical oscillations are excited on long helices that the oscillations are of a definite frequency, corresponding either to the fundamental or one of the harmonics of the helix used. In an article in the London *Electrician* (January 3), C. J. Watson finds this is not the case when the helices are excited by electrostatic induction. In fact, if it be attempted to produce an oscillation on the helix corresponding to one-fourth wave-length, it will be found that the node of potential will not be at the end where the oscillations are excited, but at a little distance from it, and this distance will vary with the capacity of the inducing arrangement. The experiments were conducted with a helix 189 centimetres long, having about 8,500 turns of copper wire. This was connected to an oscillating circuit and the latter was varied until resonance was obtained in the helix, which was shown by a vacuum tube, one end of which was connected to the earth, the other end being directed toward the helix. It was found by varying the capacity interposed between the helix and the oscillating circuit that the distance of the node from the end could be changed. In each case it was necessary to change the inductance of the oscillating circuit in order to obtain the best effect. When the coupling capacity was large the separation of the node of potential from the end of the helix was slight. Cutting out this condenser moved the node nearly to the centre of the helix. Similar results were obtained when higher harmonics were produced, and when the free end of the helix was connected to the ground.

An Automatic Shoe-Cleaning Company.

An electrical shoe-cleaning company has been established by the Westmoreland Automatic Shoe-Cleaning Machine Company in New York city. The company has quite an extensive establishment in the theatre district of the city, and it is its intention to establish similar places in different parts of New York and other cities. By the insertion of a nickel in the slot one shoe is first polished by revolving brushes driven from a small motor. The machine stops automatically and a signal is given to insert the other boot. On pressing a button the motor is again started and the polishing process is completed.

Current Electrical News

DOMESTIC AND EXPORT.

ELECTRIC ROAD FILES MORTGAGE—The Paducah (Ky.) Southern Electric Railroad Company has filed a mortgage to the Windsor Trust Company, of New York, for $2,000,000. The final survey of the road from Mayfield to Paducah is under way.

NEW OKLAHOMA INTERURBAN—A charter has been issued by the secretary of state of Oklahoma to the Fort Smith, Checotah & Shawnee Interurban Railway Company, with $500,000 capital stock, and headquarters at Checotah. It proposes to build an electric line 160 miles in length, from Fort Smith, Ark., to Shawnee, *via* Checotah.

TROLLEY MERGER APPROVED—Governor Stuart has approved the merger of four trolley lines in Northampton county as the Easton Transit Company, with a capital of $2,000,000. The companies are the old Easton Transit, Easton & Bethlehem Transit, Easton, Palmer & Bethlehem and Northampton Central. H. R. Fehr, Easton, is president, and S. H. Sargeant, Philadelphia, secretary and treasurer.

WESTERN ONTARIO VOTES FOR NIAGARA POWER—The power by-laws submitted throughout Western Ontario to enable the various municipalities to participate in the project of the Hydro-Electric Commission for the distribution of Niagara power in the region between the falls and points as far west and northwest as St. Thomas and Stratford were, generally speaking, carried by large majorities, being defeated in only one industrial centre, Ingersoll, where a proposal to spend $50,000 on the purchase of the Ingersoll Light Company's plant was defeated.

SOUTHERN NEW ENGLAND TELEPHONE COMPANY TO VOTE ON NEW STOCK ISSUE—At the annual meeting of stockholders of the Southern New England Telephone Company, on January 28, a proposal will be voted upon to authorize new stock to an amount of $2,000,000 to extend and develop the company's business on such terms as the directors shall determine. The authorized capital stock is $10,000,000, and the amount now outstanding is $8,000,000. The stockholders will also be asked to authorize an increase in the number of vice-presidents.

GEORGIA RAILWAY AND ELECTRIC—The annual statement of the Georgia Railway and Electric Company shows an increase of 100 per cent in cash fares during the last five years. The cash-fare receipts last year were $1,819,270, compared with $940,006 five years ago, the time of the consolidation of the two trolley systems in Atlanta. During the past year the company carried 46,000,000 passengers under its universal transfer system, and spent $1,000,000 in improvements and extensions. Under a recent ruling of the Georgia Railroad Commission, all city employés, who have heretofore ridden free, must pay fares, including firemen and policemen.

RECEIVERS ASKED FOR ELECTRIC ROADS—Application has been made to Supreme Court Justice Mills, at White Plains, N. Y., for the appointment of temporary receivers for the West Chester Electric Railway Company and the Yonkers Railroad, pending an order to show cause why the two corporations should not be dissolved. According to the petitions filed in the court, the two corporations, counting their bonded indebtedness, owe more than $5,000,000. Justice Mills in his order directs that all persons having any interest in or claims against the company shall show cause before George W. Alger, of 73 Nassau street, New York city, who is appointed referee, on March 9 next, why the corporation should not be dissolved. A similar order in the Yonkers trolley road proceedings was also made.

LEGAL NOTE.

OBLIGATION OF TELEGRAPH COMPANY—A telegraph company is held, in Klopf *vs.* Western Union Telegraph Company (Tex.), not to perform its obligation merely by attempting to deliver a telegram in the suburb of a city to which it is directed, where its office is in the city, and the true address, which is within its delivery limits, could be ascertained by the exercise of reasonable diligence.

TELEPHONE AND TELEGRAPH.

BATAVIA, OHIO—Receivers have been appointed for the Citizens' Telephone Company, of Batavia. The company's capital stock is $150,000. It controls 1,000 telephones, has eleven exchanges and 250 miles of wire. The applicant for receiver stated that the company owed $21,000. The failure is attributed to low rates for service and increased operating expenses.

PHILADELPHIA, PA.—At the Keystone Telephone Company's annual meeting in Camden, the directors were reelected. The company has used surplus earnings for betterments and extensions. The purchase of the Eastern Telephone Company, of Camden, cost $300,000, of which $30,000 has been paid off. For the six months ended December 31, 1907, the surplus over fixed charges was $542,598.

SCRANTON, PA.—A county telephone company to be known as the Chapman Lake Telephone Company has been organized and a charter granted it by the governor. It is capitalized at $5,000. The company proposes to operate lines for the use of individuals, firms and corporations and do a general telephone business. The route has been mapped out to begin in Jermyn borough, extending along Rush Brook road through Mayfield, Carbondale and Scott townships, leading to Chapman Lake and then on through Greenfield and Tompkinsville townships. The company will also string lines through the adjoining townships of Benton and North Abington. The directors of the company are: J. Nelson Graves, A. B. Winter, Lewis E. White, David White, Charles F. Baker and John M. Graves.

MONTPELIER, VT.—The annual meeting of the Orange County Telephone Company was held on January 7 in Chelsea. The reports of the secretary-treasurer, R. H. Williams, showed that the company had enjoyed a very prosperous year and, considering the amount of new construction work done, is in excellent condition. The company added about 200 new telephones, strung about 150 miles of new wire, built new trunk lines from Randolph to Northfield, Montpelier to Northfield, and is building trunk lines from Montpelier to Barre, Montpelier to Worcester and Montpelier to Plainfield. When the line is completed to Worcester it will have a metallic circuit by the way of Woodbury to St. Johnsbury. The Barre line will be finished in a short time. It was voted to reduce the number of directors from nine persons to five. The following were elected: C. S. Spear, of West Corinth; E. H. Kennedy, of Chelsea; A. E. Covell, of Montpelier; Dr. E. E. Ellis, of Brookfield, and Harry Daniels, of East Montpelier. Following this meeting the directors organized and elected officers as follows: President, E. H. Kennedy, of Chelsea; vice-president, C. S. Spear, of West Corinth; secretary-treasurer, R. H. Williams, and auditor, Stanley C. Wilson, of Chelsea.

ROCK ISLAND, ILL.—The annual meeting of the Crescent Telephone Company, the mutual line which covers the upper end of Rock Island county and the southern part of Whiteside county, was held at Joslin on January 6. There were 200 present. President W. H. Whiteside presided and reports of officers were read. The treasurer submitted figures which showed that the income of the company was $3,817.21 last year, while the expenses were $4,940.97. To pay the indebtedness and provide for future needs it was voted to increase the annual dues from $2.50 to $5. It was also voted to increase the capital stock from $12,500 to $25,000 and the number of shares of stock from 500 to 1,000. There were seventy-two new members received during the year and the total membership was 497, leaving but three more members admissible under the old rules. The company now has 600 miles of wire. The following officers were elected: President, W. H. Whiteside, Joslin; vice-president, George Mason, Erie; treasurer, E. H. Hanson, Hillsdale; secretary, A. A. Matthews, Erie. Directors: William Zeigler, Hampton; William Farber, Port Byron; D. W. Mumma, Zuma; Jerry Pearsall and Joseph Dillon, Canoe Creek; Mr. Seegur, Erie; Mr. Bade, Newton; Robert James, Benton.

ELECTRIC RAILWAYS.

FORT COLLINS, COL.—Street-car service has been inaugurated on the Fort Collins division of the Denver & Interurban Railway.

BRUNSWICK, GA.—Construction will be started immediately, it is said, by the City & Suburban Electric Railway Company on its proposed lines.

NAPA, CAL.—The San Francisco, Vallejo & Napa Valley Electric Road has formally opened for traffic its extension from this city to St. Helena, eighteen miles north.

NEW IBERIA, LA.—H. R. Fine, superintendent of construction of the Bayou Teche Electric Light and Railway Company, states that work on the road will commence immediately.

BOSTON, MASS.—The railroad commission has approved of an issue of $25,000 additional stock by the Concord, Maynard & Hudson Street Railway Company, to be issued at $100 per share.

ATLANTA, GA.—It is reported that Joel Hurt, a prominent trolley-line builder, will soon begin the construction of an electric interurban line from Atlanta to Decatur, a distance of six miles.

AMERICUS, GA.—A. N. Walker, the newly elected president of the Americus Railway and Light Company, has announced that he will begin at once the construction of proposed electric lines in this city.

HARRISBURG, PA.—The Lancaster & York Furnace Trolley Company, which is a part of the new system on the lower Susquehanna, has increased its bonded debt $150,000, according to a statement filed at the capitol.

MINEOLA, L. I.—The New York & North Shore Traction Company has made application to the Nassau county supervisors for a franchise to build a trolley from Mineola to Westbury. The board fixed January 27 for a hearing on the application.

EVANSVILLE, IND.—P. J. Kolb, of Mt. Carmel, Ill., announces that at a meeting held recently at Olney, Ill., a company was organized to build a traction line from Olney to Mt. Carmel and finally to this city, crossing the Wabash river at Mt. Carmel.

ALLIANCE, OHIO—At the Stark Electric Railway annual election C. R. Morley, David Morrison, E. Wiebenson, F. Strauss, William Grief, E. F. Cook and H. Boemke, all Cleveland men, were named directors. Mr. Morley was chosen president, and C. M. Mowry superintendent.

KENOSHA, WIS.—The last consignment of material for the extension of the Kenosha Electric Railway Company has arrived and work will be started as soon as practicable. The road is owned by A. C. Frost, of Chicago, who is president of the Chicago & Milwaukee Electric line. The franchise of the company was recently extended by the council.

SHAMOKIN, PA.—At the annual meeting of the stockholders of the Shamokin & Edgewood Electric Railway Company the following officers and directors were elected: Monroe H. Kulp, president and general manager; G. Gilbert Kulp, vice-president; M. H. Barr, secretary and treasurer; D. C. Kaseman, H. W. Shuman, W. J. Wiest and Jerome Reed, directors.

NEWPORT, WASH.—The survey of the electric road from Priest river to Priest Lake has been completed and it is reported that the scheme has been financed and the road will be constructed during the coming year. It is probable that the Spokane and Newport line will be extended from this city to Priest river and will thus afford a through line from Spokane to Priest Lake.

ROCHESTER, N. Y.—At the annual meeting of the Rochester & Suburban Railway Company, a subsidiary of the Rochester Railway Company, directors were elected as follows: Horace E. Andrews, William K. Vanderbilt, Jr., E. V. W. Rossiter, A. H. Harris, John Carstensen, W. C. Brown, W. N. Kernan, George W. Archer and Charles T. Chapin. This is the road to Sea Breeze and Summerville.

NEW YORK, N. Y.—Announcement is made that Francis A. Stratton has purchased the Putnam & Westchester Traction Company's trolley line from Peekskill to the Putnam county line. The road will form an important link in connection with the plan of Mr. Stratton, who now controls a line from Peekskill to Ossining and who will build a trolley road from there to Pleasantville, White Plains and Mount Vernon.

MIDDLEBURY, VT.—At the annual meeting of the Champlain Valley Traction Company directors were elected as follows: R. W. McCuen, R. H. Noonan, O. A. Smith, Frank Allen, W. A. Jennings, C. M. King, S. E. Smith, S. W. Ward and J. C. S. Hamilton. The directors organized as follows: President, Frank Allen, of Fair Haven; vice-president, O. A. Smith, of Addison; secretary, S. W. Ward, of Shoreham; treasurer, R. W. McCuen, of Vergennes.

CANTON, ILL.—At the annual meeting of the stockholders of the Illinois Central Electric Railway five directors to succeed those whose terms had expired were elected as follows: S. W. Furry, T. B. Bass, J. V. Brokaw, G. W. Gaddis, of Fairview, and George W. Chandler. The directors holding over are: J. L. Andrews, C. L. Whitnah, G. W. Shawver, J. E. Shafer, R. F. Henkle, M. W. Rafferty, L. W. Morton, E. A. Heald, W. D. Plattenburg and William Hanlon.

HOUGHTON, MICH.—The Calumet & Lac la Belle Traction Company has started active operations on its line. A force of men was set to work at the Mohawk end of the new line and will work toward Calumet. Operations are to be pushed vigorously until such a time as the entire line is completed from Mohawk to Calumet. Later plans will be made for the extension to other points in Keweenaw and Houghton counties, and ultimately the tracks will be continued to Lac la Belle.

ALLENTOWN, PA.—The Franklin & Towamensing Street Railway Company, which has a charter for the building of a street railway from Slatington to Lehighton, through Palmerton and Bowman's, has opened an office at Slatington, and has engaged I. W. Cramp, of Harrisburg, a civil engineer, to begin at once the preliminary surveys. It is likely that this year will see at least a portion of the road built and in operation. Several Allentown capitalists are interested in the company.

PADUCAH, KY.—The surveys for the proposed interurban line between Paducah and Mayfield have been completed and the engineers are now at work on maps and estimates. Two routes were surveyed, one of which parallels the Illinois Central Railroad. The Paducah Southern Electric Railway Company, which proposes to construct the road, claims to have arranged to float its bonds, and will start work in a short time. The company expects to be operating cars by the middle of the summer. The rights of way have been secured.

PUYALLUP, WASH.—At a mass meeting the people expressed themselves in favor of giving the Tacoma Railway and Power Company an extension of four months to build the line between Tacoma and Puyallup; that $30,000 be expended in construction before June 19, 1908; that the contract for the bridge over the Puyallup river be let within thirty days; that a bond of good faith in the sum of $1,000 be furnished by the company, all to be forfeited to the city of Puyallup in case of non-compliance with the terms of the franchise.

MASSILLON, OHIO—The Massillon, Wooster & Western Electric Line, the title of the new line which is headed by Col. C. V. Hard and other Wooster citizens, has started active work surveying the line. These directors were elected: C. V. Hard, M. L. Smyser, Nick Amster, A. J. Heiler, of Orrville; John C. Schultz, E. S. Landis, A. D. Metz, H. H. Freedlander and D. F. Griffith, of Orrville. The directors organized by the election of officers as follows: President, C. V. Hard; vice-president, M. L. Smyser; secretary, E. S. Landis; treasurer, Nick Amster.

NORWALK, OHIO—The project of a new electric road from Bucyrus to New Washington has been revived at Bucyrus by J. L. Weadock, of Toledo. The Buckeye Traction Company, which has a private right of way between Bucyrus and New Washington, is said to have disposed of its interests to the Sandusky, Norwalk & Mansfield Electric Railway Company, which may mean the revival of the proposed road from Chicago Junction to New Washington and Bucyrus, on which considerable preliminary work was done a year or more ago.

BOISE, IDA.—The three lines of the Boise Valley Railway Company, which have been so far built and operated by the Boise Valley Construction Company, have been turned over to the Boise Valley Railway Company; that is to say, the Boise Valley line from Boise

to South Boise; from Boise to the fair grounds and cemetery, and from Boise to Ustick and Onwiler will hereafter be operated solely by the Boise Valley Railway Company and not by the construction company. The railway company will make no material change in the operation of the different lines.

NILES, MICH.—Announcement is made that the Southern Michigan Railroad Company, now operating an electric interurban railway thirty-five miles in length, and which connects St. Joseph, Niles and South Bend, will build a line between Kalamazoo and Niles. The Southern Michigan Railway Company is allied with the Northern Indiana Railway Company. The latter company operates an extensive system, including lines from South Bend to Elkhart, the Northern Indiana, and another line between Laporte and Michigan City, with city lines in Michigan City, Elkhart, South Bend and Goshen.

MILWAUKEE, WIS.—Active building operations on the Milwaukee-Northern electric road to Sheboygan will be begun as soon as weather conditions permit. It is expected that the line will be ready for operation by June 1, all that remains to be done being the grading of one-half the distance between Port Washington and Sheboygan, the stringing of wires and laying of track for that distance. Two new Allis-Chalmers gas engines are now being installed at the Port Washington power-house, and the rolling stock has been purchased. It is expected that the Chicago & Milwaukee electric line will be ready by the same date.

ATLANTA, GA.—Plans are under way for securing a charter for the Atlanta, Norcross & Gainesville Railway Company, which will extend from Atlanta to Gainesville, a distance of sixty miles. It will touch Chamblee and Doraville in DeKalb county, Norcross and Buford in Gwinnett and thence through Hall to Gainesville. The capital stock will be $15,000, with the privilege of increasing the same. The right to own and operate electric powers is also sought. The incorporators are all Hall county men, and are as follows: H. D. Jaquish, C. C. Sanders, W. B. Smith, J. H. Hunt, R. Smith, A. J. Mundy, H. B. Smith, M. M. Ham, J. W. Bailey, H. H. Dean and J. L. B. Stevens.

NORTH YAKIMA, WASH.—At a meeting of the directors of the Yakima Valley Transportation Company it was decided to make every effort to retain the whole of the stock of the trolley system in the hands of local investors, and an active campaign shortly will be inaugurated to secure the remainder of the capital required for construction work. The directors believe conditions are such that practically every mile of the proposed road will be self-sustaining from the outset, with the certainty of a steady increase in freight and passenger traffic. A very large portion of the necessary outlay already has been provided for, and the directors claim that $100,000 would put them in a position to complete the entire system.

STREATOR, ILL.—The McKinley interurban syndicate has accepted the franchise granted it by the city council of Streator. According to the agreement now existing between the city councils of Ottawa and Streator, work on the construction of the line must be commenced not later than March 1, 1908. The expenditure of at least $100,000 by the interurban company during the year is also required. As the location of the commencement of work is not specified in the franchises, it is more than probable that operations will be started in the construction of the road at both ends of the route, thus facilitating the work. Orders for rails, clamps and other material necessary for the track construction have been placed and the work, when commenced, will be hurried to completion.

WARSAW, N. Y.—Advices regarding the building of the Rochester, Scottsville & Caledonia Electric Railroad to LeRoy and Batavia, with a branch south of Warsaw and Perry, a distance of fifty-two miles to Portage Falls and including branches, seven miles, it states that surveys for the preliminary route have been completed for the entire distance. The road will start from Rochester and serve the following-named towns: Scottsville, Caledonia, LeRoy, Pavilion, Perry, Castile and Portage, with branches from Pavilion to Warsaw, twelve miles, and from LeRoy to Batavia, ten miles. The grade will not exceed three per cent, and there will be only slight curves. The road will be built for high-speed service on private right of way, and will be laid with seventy-pound rails. The bridges will be all-steel structures. Work on the construction will be started as soon as the bonds have been disposed of.

NASHVILLE, TENN.—The Nashville Interurban Railway Company, which contemplates an electric line from here to Mt. Pleasant, has contracted with the Nashville Railway and Light Company for power to operate cars between here and Franklin, which section of the line will be ready for operation July 1. The interurban cars will enter Nashville over the Glendale park line of the Nashville company, and pass through the transfer station of that company. An hour schedule will be maintained between Nashville and Franklin, the distance being eighteen miles. The track will be laid with seventy-pound rails. H. H. Mayberry, president of the interurban company, said that the construction beyond Franklin would not begin till after the line to Franklin was in operation. He said the work on this end of the line had not stopped a day during the financial troubles, and that the company had ample funds.

SALT LAKE CITY, UTAH—Early this coming spring the Utah Light and Railway Company will, in all probability, begin work on its proposed 2,000-horse-power electrical power plant in Weber Cañon, eighteen miles east of Ogden. The plant has been under consideration for a year or more, and the company has owned part of the site upon which it will go for about four years. Recently the company purchased from the Utah Construction Company its interest in the site, and since that time has done enough work upon it to hold the title to the water rights. With the extension of the street-car lines here and in Ogden, more power will be needed, and it is expected that by the close of 1908 the proposed new plant will be a necessity. The latter will cost between $200,000 and $300,000. The site is at Devil's Gate, on the Weber river, and is considered one of the best power plant sites in Utah. With this plant erected and the steam plant in Salt Lake reconstructed, the Utah Light and Railway Company will have at its disposal about 15,000 horse-power.

LINCOLN, NEB.—The annual meeting of the stockholders of the Citizens' Railway Company was held January 7. The records showed the revenue from operation to have been, in round numbers, $55,000, and the net income $22,000. The company began the year with three or four cars and closed the year with fourteen cars in operation. The average amount invested during the year was $135,000. The stockholders instructed the board of directors to place on the market $300,000 in new stock to be used for extensions. Construction work was ordered pushed during the year to come. The addition to the capital stock authorized will bring the total issue up to half a million. These directors were elected: W. E. Sharp, I. M. Raymond, T. P. Kennard, E. J. Hainer, A. O. Faulkner, Mark Woods, C. J. Bills, George J. Woods, R. E. Moore, C. T. Boggs and J. E. Miller. Changes on this board are: Messrs. Faulkner, Hainer and Bills take the places formerly held by S. W. Burnham, W. C. Wilson and F. M. Hall. These officers were elected: W. E. Sharp, president; J. H. Smith, treasurer; George J. Woods, secretary.

TERRE HAUTE, IND.—Construction of the Terre Haute & Merom traction line has been made possible by a number of local business men who look on the line as a paying investment. The United States Construction Company, of Terre Haute, has filed incorporation papers, with a capital stock of $10,000. The company is formed to repair and build interurban railways. The directors are: D. E. Schmidt, D. M. Roberts and J. S. Sweeney, and the contract for the construction of the Terre Haute & Merom traction line was let to the company. The interurban line is to be built entirely with scrip. Six per cent semi-annual first mortgage thirty-year bonds of the amount of $750,000 will be placed in the hands of one of the Terre Haute banks as security. The new line will run through Prairieton, Middleton, Fairbanks, Scott City and Staffordshire to Merom. It is expected eventually to build the line to Robinson. A survey of the line was made several months ago, but a new preliminary survey has been made in order to eliminate the heavy grades of the old one. It is hoped to make the grade one-half of one per cent in order that car loads of coal can be handled easily. Franchises to cross the roadways of Vigo and Sullivan counties have been secured. The new company is negotiating with the Terre Haute, Indianapolis & Eastern Traction Company in regard to the use of its tracks to enter the city. In this manner the securing of a Terre Haute franchise will be avoided.

PERSONAL MENTION.

MR. S. B. DUTCH has been made manager of the Citizens' Electric Company, of Dayton, Ohio, succeeding Cyrus E. Mead. Mr. Mead remains secretary of the company.

MR. LISLE BENNION has been appointed acting manager of the lighting and traction systems of the Illinois Light and Traction Company, at Streator, Ill., succeeding R. W. Harris, who resigned to accept the superintendency of an interurban system at Pittsburg, Kas.

MR. B. M. BROWN, of Dayton, Ohio, has been made general superintendent of the Cincinnati Northern Traction Company, to succeed C. E. Palmer, resigned. For the past two years Mr. Brown has been superintendent of the Dayton & Western division of the Schoepf traction lines.

MR. E. J. DICKSON has been appointed assistant general manager of the Interstate Consolidated Street Railway Company, Pawtucket, R. I., controlled by the Rhode Island Company. Mr. Dickson has for some time been connected with the Milford, Attleboro & Woonsocket Street Railway Company, Milford, Mass.

MR. JOHN H. BRICKENSTEIN, former examiner in electricity and metallurgy and late senior member of the Board of Examiners in Chief of the United States Patent Office, has become associated with Byrnes & Townsend, of Washington, D. C. The new firm will practice law under the name of Byrnes, Townsend & Brickenstein.

NEW INCORPORATIONS.

AUSTIN, TEX.—Woods Electric Company, of Houston. An amendment changing its name to Tel-Electric Company.

LANSING, MICH.—Farmers' Telephone Company, of Jackson. An amendment increasing its capital stock from $10,000 to $50,000.

BUFFALO, N. Y.—Keyes Electric Company. To supply heat and light to villages near Buffalo. $12,000. Directors: Samuel G. Keyes, Jennie E. Keyes and J. G. Keyes.

BATH, N. Y.—Citizens' Electric Service Company, of Bath. $50,000. Directors: E. J. G. Tower, W. H. Hallock, Thomas Shannon, E. S. Underhill, Bath; William S. Bricknell, Buffalo.

CAMDEN, N. J.—Lykens Valley Construction Company. To operate a trolley line. $125,000. Incorporators: Walter E. Harrington, of Pottsville; C. Paul Hagenlocher, Nathan D. Yoder, of Hegins, and William B. MacDonald, of Camden.

NEW PUBLICATIONS.

CLAIM AGENTS' ASSOCIATION—The report of the fourth annual convention of the Claim Agents' Association, held in conjunction with the annual convention of the American Street and Interurban Railway Association, at Atlantic City, N. J., October 14, 15 and 16, 1907, has been published.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION—The proceedings of the Kansas Gas, Water, Electric Light and Street Railway Association, containing the report of the tenth annual meeting, held at Topeka, Kan., October 9 and 10, 1907, have been issued.

NAVY DEPARTMENT—The annual reports of the Chief of the Bureau of Navigation and of the Chief of the Bureau of Construction and Repair, to the Secretary of the Navy, Washington, D. C., for the fiscal year 1907 have been issued. These give detailed accounts of the activity of the bureaus during the year.

HOW TO BURN ILLINOIS COAL WITHOUT SMOKE—The engineering experiment station of the University of Illinois has issued a bulletin (No. 15) entitled, "How to Burn Illinois Coal Without Smoke." This has been prepared by Professor L. P. Breckenridge, director of the station, and it explains the principles of combustion, showing how smoke is produced, and then describes the methods employed for observing and classifying, and the modifications which may be made in ordinary boiler settings without great expense, whereby smoke is prevented. The general principle is to use tiles so as to prevent the gases from coming in contact with cold metal until combustion has been completed. If this be done it is almost impossible to produce smoking even when the boiler is forced.

ELECTRICAL SECURITIES.

A number of substantial advances in the prices of securities were registered last week as a result of the continued short covering. Trading was active, with a noticeable improvement in bond transactions. The belief is general, however, that some reaction may be looked for, though this will probably be of a temporary character, and be followed by a still more general advance. The money market continues to ease, call money lending at six per cent during the week. The placing of Amalgamated Copper on a two-per-cent annual dividend basis—a reduction of fifty per cent—was not unexpected, and its effect had been largely discounted. Railroad earnings are showing some declines, and trade conditions in general, while somewhat improved, still show the effect of the financial depression.

Dividends have been declared upon the following electrical securities: Syracuse Rapid Transit Railway Company; an initial dividend of three per cent on its common stock, payable February 1. Rochester Railway and Light Company; an initial dividend of five per cent ($5 per share, par $100, $70 paid in) on the common stock, payable January 15. West Penn Railways Company; regular quarterly dividend of one and one-fourth per cent on the preferred stock, payable February 1. Twin City Rapid Transit Company; regular quarterly dividend of one and one-fourth per cent on the common stock, payable February 15 to stockholders of record February 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JANUARY 18.

New York:	*Closing.*
Allis-Chalmers common	6½
Allis-Chalmers preferred	19½
Brooklyn Rapid Transit	46¾
Consolidated Gas	103¼
General Electric	122½
Interborough-Metropolitan common	3¼
Interborough-Metropolitan preferred	22¾
Kings County Electric	90
Mackay Companies (Postal Telegraph and Cables) common	57⅝
Mackay Companies (Postal Telegraph and Cables) preferred	62½
Manhattan Elevated	124
Metropolitan Street Railway	26
New York & New Jersey Telephone	99½
Western Union	59½
Westinghouse Manufacturing Company	52

The Consolidated Gas Company has authorized $5,000,000 six-per-cent one-year notes, of which $1,500,000 has been already sold to N. W. Harris & Company.

The annual meeting of stockholders of the Brooklyn Rapid Transit Company for the election of four directors to serve three years, and of three inspectors of election to serve at the next succeeding annual meeting, and for the purpose of transacting such other business as may be duly brought before the meeting, will be held at 12 o'clock noon on Friday, January 31, at the office of the company, 85 Clinton street, borough of Brooklyn, New York city.

Boston:	*Closing.*
American Telephone and Telegraph	109⅞
Edison Electric Illuminating	210
Massachusetts Electric	49
New England Telephone	118½
Western Telephone and Telegraph preferred	65

Directors of the Western Telephone and Telegraph Company have declared a regular semi-annual dividend of two and one-half per cent on the preferred stock, payable February 1 to stockholders of record January 18.

Philadelphia:	*Closing.*
Electric Company of America	8⅜
Electric Storage Battery common	30½
Electric Storage Battery preferred	30½
Philadelphia Electric	6⅜
Philadelphia Rapid Transit	17½
United Gas Improvement	79¾

Chicago:	*Closing.*
Chicago Telephone	118
Commonwealth Edison	90
Metropolitan Elevated preferred	49
National Carbon common	54
National Carbon preferred	104

The Chicago Telephone annual meeting has been postponed till February 12.

Directors of the Commonwealth Edison Company have declared the regular quarterly dividend of one and one-fourth per cent, payable February 1.

ELECTRIC LIGHTING.

RANTAUL, ILL.—The Flanagan village board, it is said, is contemplating the installation of an electric light plant.

BELLEVILLE, ILL.—The new municipal electric light plant of Swansea, a suburb of Belleville, has been completed. The plant cost the village $10,411.

PITTSBURG, PA.—The city has awarded the arc-lighting contract to the Allegheny Light Company, at a rate of $90 per light where underground circuits are used, and $72 per light with overhead wires.

HUDSON, N. Y.—The Albany & Hudson Railroad Company will furnish electric light in Hudson until such time as a permanent contract is made. The city will look into the question of installing a municipal plant.

PATCHOGUE, N. Y.—A deal has been completed resulting in the transfer of the control of the Patchogue Electric Light Company from J. F. Heyward and a coterie of Baltimore capitalists to a syndicate of local citizens.

BOULDER, COL.—The city council has appointed a committee to confer with electrical engineers as to the probable cost of installing an electric light and power plant to be run in connection with the city's waterworks.

CALIFORNIA, MO.—The California Electric Light and Power Company has leased its plant in this city to L. H. Ades, of Rockport, Ill., and Edwin Boyd, of Tipton. It is understood that the plant will be enlarged and the service extended to Tipton.

ATTICA, N. Y.—The trustees of this village have entered into a contract with the Attica Water, Gas and Electric Company to furnish twenty-eight arc lights of 2,000 candle-power each and thirty-eight incandescent lights of twenty-five candle-power each.

DETROIT, MICH.—The council has passed an ordinance introduced last March, compelling corporations owning or controlling electric feed wires, except trolley wires, within a half-mile circle of the city hall, to place them underground in conduits on or before January 1, 1909.

TROY, N. Y.—The Troy Gas Company, at a recent meeting, decided to extend its service so that it will be able to supply the residents of the East Side with electricity for lighting their houses and stores. The wires for the purposes will be extended throughout that section of the city.

CORONA, CAL.—On account of the marked increase of local business, the Corona Gas and Electric Light Company will at once build a line seven miles in length to the Pedley power-house, which will be capable of transmitting 17,000 volts of the electric current to its plant in this city.

KNIGHTSTOWN, IND.—The question of reconstructing the municipal electric light plant at a cost of $12,000, and the issuance of bonds with which to meet the expenditure, was submitted to a vote of taxpayers on December 26, and the result was 241 in favor of the reconstruction, with only forty-four negative.

WENATCHEE, WASH.—Wenatchee has entered into a contract with the Wenatchee Electric Company whereby Wenatchee will be lighted with arc lights. The lights were ordered some time ago and the electric company expects to have them installed by February 15. The company has also installed a gas plant costing approximately $60,000.

TAMPA, FLA.—At the annual election of the Tampa Electric Company the entire list of officers was reelected. Reports read showed that the gross receipts of the company were larger in 1907 than in any previous year. Many improvements have been planned for the coming year by the Stone & Webster syndicate which operates the company.

HUTCHINSON, KAN.—The Supreme Court of the United States has handed down a decision in favor of the city of Hutchinson in the suit brought by the water, light and gas company of Hutchinson to restrain the city from granting a franchise to and making contract with a competing light company. The water, light and gas company claimed its franchise was an exclusive one.

TROY, N. Y.—George E. Greene, acting for the Schaghticoke Electric Company, has filed forty-seven deeds for parcels of land purchased by the company from persons owning property along the channel of the Hoosick river, upon which the power company plans to construct a plant. Most of the land secured will be flooded after the erection of the contemplated dam.

CHRISTIANBURG, VA.—The town has sold to John L. Vaughn and his associates its electric-light plant. The new owners will at once form a company for the purpose of operating it. The price paid, together with the amount derived from the old plant, will wipe out the town's indebtedness at maturity. The town will receive its present system of arc lights free of all costs.

WAPAKONETA, OHIO—The village of New Bremen, which already owns its own waterworks system, has purchased the plant of the New Bremen Electric Light Company for $14,000. This puts an end to the two years of litigation between the village and the electric light company, whose franchise had expired. The village issued $20,000 worth of bonds to purchase and rebuild the plant.

LOUISVILLE, KY.—At a meeting of the stockholders of the Kentucky Electric Company the following directors were chosen: Lawrence Jones, Louis Seelbach, R. Baylor Hickman, James A. Shuttleworth, Fred Levy, James Kirwan, Donald McDonald, Charles J. Doherty, William Doherty, John Starks, Robert E. Hughes. The officers were elected as follows: President, R. E. Hughes; vice-president, Lawrence Jones; secretary, Byron Allen.

HAVERHILL, MASS.—The Haverhill Electric Company will expend at least $100,000 in this section during the spring burying its wires. Under act of the legislature the company will be compelled to bury the wires through Water, Merrimack and Washington streets before 1910. The company will, however, do more than this, and the conduits through the business section will be laid this summer and next year the poles and wires will be removed. The whole work will involve an expenditure of about $200,000.

BRIGHTON, COL.—The Northern Colorado Power Company is preparing to extend its power lines from Greeley to Lafayette and from Lafayette to Denver. The towns now served are Louisville, Lafayette, Superior, Boulder, Longmont, Berthoud, Loveland, Fort Collins, Timnath and Greeley. The proposed extensions will serve the towns of Windsor, Evans, Lucerne, Eaton, Ault, Niwot, La Salle, Fort Lupton, Platteville, Brighton, Erie, Lyons, Johnstown, Mead, Canfield, Wellington and other places. The present population served is 75,000, and the extension will serve 25,000 more.

SUMAS, WASH.—To increase its power from 3,200 horse-power to 10,000 horse-power, the Whatcom County Railway and Light Company has men engaged in surveying the route for a flume to be built near the nine-mile post on the state road leading out of the Nooksack river to the plant at Nooksack falls. In the narrow gorge of the nine-mile post the company proposes to build a large cement dam in order to raise the water in the river. From this dam a flume will be built which will be of dimensions large enough to carry the entire average flow of the river. The flume will be about two and one-half miles in length and will give a fall sufficient to increase the capacity of the power plant 300 per cent.

EDUCATIONAL NOTE.

PUBLIC LECTURES ON ELECTRICITY—The Department of Education of the city of New York has announced a course of nine lectures on electricity, by W. Walter Ker, of the Hebrew Technical Institute, to be delivered at Public School No. 2, Third avenue, between One Hundred and Sixty-ninth and One Hundred and Seventieth streets, New York city. Four of these lectures have already been given. The remaining five are as follows: January 31, "Safety System of Electric Railways"; February 7, "The Steam Turbine"; February 14, "The Gasolene Automobile—Part I"; February 21, "The Gasolene Automobile—Part II"; February 28, "Wireless Telephony." Mr. Ker is also delivering a course of eight lectures on electricity at Public School No. 118, Fourth avenue and Fifty-ninth street, three of which have been given. The following are still to be delivered: January 28, "Incandescent Electric Lighting"; February 4, "Electric Arc Lighting"; February 11, "Electroplating and Electrotyping"; February 18, "Electric Motors and Their Application"; February 25, "Methods of Electrical Communication."

INDUSTRIAL ITEMS.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is sending out a bulletin describing and illustrating the Jeffrey centrifugal fan for mine ventilation. These fans are built in sizes to suit every condition.

THE NEW YORK INSULATED WIRE COMPANY, New York city, has issued a leaflet giving prices and a general description of its friction and rubber tapes. The company will be pleased to mail copies of this leaflet, together with samples, to those interested.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces the opening of a repair department at its works. Ample space has been provided, and the equipment and facilities are such as to insure the prompt return of the repaired apparatus. For the present, repairs will be undertaken on apparatus of Westinghouse manufacture only.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is distributing bulletin No. 1102, containing a list of plants in which the company's types MP and MPL direct-current, direct-connected generators have been installed; and bulletin No. 1103 descriptive and illustrative of its series alternating-current arc-lighting system. An index to bulletins Nos. 1001 to 1103 has also been prepared.

THE ART MACHINE COMPANY, 217 Fulton street, Brooklyn, N. Y., through its electrical department, has ready for the market its line of "Economy" electric soldering and branding irons and its electric irons for domestic service. The "Economy" electric flat-iron is made in four-pound, six-pound, eight-pound and nine-pound sizes. These take, respectively, 200, 300, 400 and 500 watts at sixty, 115 and 215 volts.

THE MURRAY IRON WORKS COMPANY, Burlington, Iowa, has published a valuable bulletin entitled "The Nomenclature of Murray Corliss Engines." This bulletin shows a number of detail illustrations explaining the make-up and operation of these machines. The company also builds air-compressors, pumping engines; tubular, water-tube and internal furnace boilers, feed-water heaters and complete power plants. Copies of this catalogue, which is designated as series D, No. 7, will be furnished upon request.

THE LORD ELECTRIC COMPANY, 213 West Fortieth street, New York city, and Boston, Mass., announces that it has concluded arrangements with Charles I. Earll for the manufacture and sale of his trolley retriever and catcher. The company states that the device is ingenious, strong and durable, easy of access, and built on sound engineering principles. Many large companies throughout the United States have adopted it, with entirely satisfactory results. The Lord Electric Company has also taken over all rights, title and interest in patents granted and pending W. P. Cosper, covering controller regulators. Mr. Cosper is to assume the position of central western representative of the company, making his headquarters at Chicago, Ill. These controller regulators are stated to embody many new features which will appeal to the railway manager.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Waverly Park, Newark, N. J., has issued two circulars descriptive, respectively, of "Eclipse" direct-current switchboard voltmeters and ammeters, and new Weston alternating-current switchboard instruments. The direct-current instruments are of the electromagnetic type, and the name "Eclipse" has been adopted to distinguish them from the company's permanent-magnet switchboard apparatus. These instruments are stated to possess a degree of accuracy hitherto unapproached, and to be excellent in mechanical design and construction.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has issued No. 1 of Vol. I of a publication, "Common Sense," with David Gibson, editor, and W. A. Ten Winkel, publicity manager, which will hereafter be distributed monthly. This number is made up in an attractive size with an artistic cover, and the contents are bright "saws" and applications of practical common-sense ideas. The purpose of the publication is to advance the sale of the controllers, lifting magnets, magnetic brakes, magnetic switches, solenoids, etc., manufactured by this company.

THE HABIRSHAW WIRE COMPANY, Yonkers and New York, is distributing a very artistic and well-printed calendar with individual monthly leaflets, on each of which is a picture of some modern building in which the Habirshaw wires have been used in the electrical installations. Among these buildings are the following notable ones: Hotels St. Regis and Waldorf-Astoria, Hotel Belmont, Ansonia apartments, Hotel Astor, Carnegie residence, Barclay Building, Park Row Building, Hall of Records, Metropolitan Life Building, Railroad Exchange Building, Chicago; Machesney Building, Pittsburg; Belvidere Hotel, Baltimore.

THE MANHATTAN ELECTRIC RANGE COMPANY, New York city, has installed an electric range and electric grill in Reisenweber's Hotel, New York city. This range has a length of four feet, a height of six feet, and is two feet six inches deep. There are four broilers, two salamanders and one hot closet. The range consumes 150 amperes at 110 volts. The trimmings are of brass, and the body is of planished iron, and the ends and portions of the body are of white enameled tile. This range has a capacity for serving fifty to seventy-five persons per hour. The range has been thoroughly tested and has come up to all specified requirements.

Record of Electrical Patents.

Week of January 14.

876,326. AUTOMATIC ELECTRICAL RELEASE STARTER. Anthony J. Burns, Oswego, N. Y. The switch is closed by an oscillatory clutch actuated by a vertically moved member.

876,330. PROCESS OF MAKING INCANDESCENT-LAMP FILAMENTS. Walter G. Clark, New York, N. Y., assignor to Parker-Clark Electric Company, New York, N. Y. The filament is heated in the presence of a mixture composed of a volatile carbonaceous compound together with a volatile silicon containing chlorin and also in the presence of a substance having a greater affinity for chlorin than has silicon.

876 390 —INCANDESCENT ELECTRIC LAMP

876,331. PROCESS OF MAKING ELECTRIC-LAMP FILAMENTS. Walter G. Clark and Herschel C. Parker, New York, N. Y., assignors to Parker-Clark Electric Company, New York, N. Y. The filament, while in the presence of an atmosphere in which silicon may be deposited, is heated by an electric current.

876,332. PROCESS OF MAKING INCANDESCENT-LAMP FILAMENTS. Walter G. Clark, New York, N. Y., assignor to Parker-Clark Electric Company, New York, N. Y. A carbon filament is heated in the presence of a volatile silicon compound.

876,346. PROCESS OF PRECIPITATING METALS. John E. Greenawalt, Denver, Col. Silver and gold are deposited from their haloid compounds by passing the solution through shavings of an alloy of tin and lead.

876,383. MEANS FOR PRODUCING ELECTROMAGNETIC WAVES. Joseph Murgas, Wilkes-Barre, Pa. Two spark-gaps are employed, one in the primary oscillating circuit and the other associated directly with the antenna.

876,387. BRAKE-SETTING APPARATUS FOR RAILWAYS. John J. McNamee, Norwood, Ohio. An electromagnetic device for setting the air-brakes on a car, which is actuated by a contact on the track.

876,390. INCANDESCENT ELECTRIC LAMP. Herschel C. Parker and Walter G. Clark, New York, N. Y., assignors to Parker-Clark Electric Company, Jersey City, N. J. A hollow member having a refractory conducting lining.

876,400. ELECTRICAL DISTRIBUTING RACK. Charles A. Rolfe, Adrian, Mich., assignor, by mesne assignments, to Rolfe Electric Company, Rochester, N. Y. A frame having vertically disposed supporting strips with horizontal strips extended between.

876,413. POLARIZED RELAY. Chester H. Thordarson, Chicago, Ill. A working member, controlled by a polarized armature, which operates when moved in either direction.

876,416. ELECTRIC TIME-SWITCH. Robert F. S. Venner and Robert C. Griesbach, London, England. A number of clock hands which may be set to open and close a switch at any predetermined times.

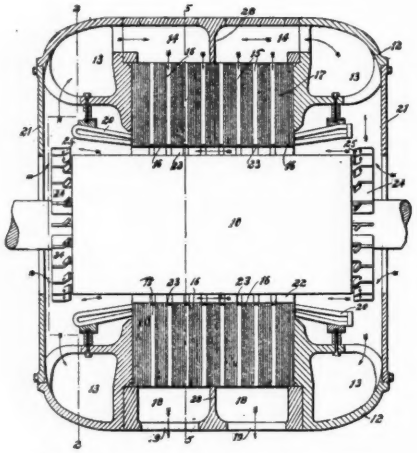
876,419. SYSTEM OF AUTOMATIC BLOCK SIGNALING FOR RAILWAYS. Samuel M. Young, New York, N. Y. A signal system adapted to a number of tracks.

876,434. NON-INTERFERING PARTY-LINE TELEPHONE SYSTEM. William R. Brown, La Fayette, Ind., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A selective system controlled by the position of the switch hook.

876,445. ELECTROLYTE FOR ALKALINE STORAGE BATTERIES. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. An electrolyte containing lithium hydroxide.

876,489. ELECTRIC RAILWAY SYSTEM. Samuel B. Rappleye and John J. Devine, Philadelphia, Pa. The contact-rail is supported beneath a curved protecting strip.

876,493. TIME INDICATOR FOR TELEPHONES. John Rounsevill and August Bilms, Cuxhaven, Germany. A minute hand driven around a graduated dial plate indicates the length of the conversation.



876,568.—Dynamoelectric Machine.

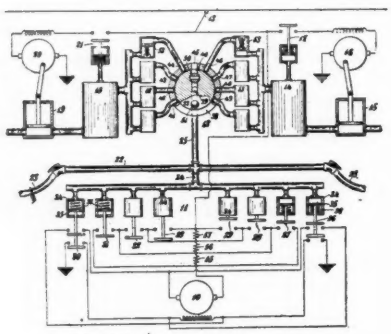
876,512. FIRE-ALARM SYSTEM. Martin A. Abrahamson, Copenhagen, Denmark. A thermostatic system.

876,552. SOCKET SHELL. Harvey Hubbell, Bridgeport, Ct. The members are provided with interlocking screw-threads.

876,555. AUTOMATIC SWITCHING DEVICE FOR USE IN FLASH ADVERTISING. Leonard K. Job, Notting Hill, London, England. A pivoted switch-arm controlled by an electromagnet.

876,568. DYNAMOELECTRIC MACHINE. Charles E. Lord, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. Passages are provided for circulating a cooling medium through the stationary member.

876,594. CONTROL SYSTEM. George B. Schley, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. A single-pipe system of multiple-unit control.



876,594.—Control System.

876,595. ELECTRICAL REGISTER AND SYSTEM THEREFOR. Louis A. Schmidt, Chicago, Ill. A tally mechanism for telephones.

876,600. TROLLEY GUARD. Charles W. Sheehan, Lubec, Me. Guards with swinging arms extend over the wheel.

876,619. JUNCTION-BOX FOR ELECTRIC WIRES. Louis P. Bliemeister, Buffalo, N. Y., assignor of one-half to William R. Jeseph, Buffalo, N. Y. An adjustable junction-box.

876,630. MEANS FOR LOCKING CAPS TO SOCKET SHELLS, CANISTERS, ETC. Arthur C. Gaynor, Bridgeport, Ct. Projecting ribs on the case lock in corresponding spaces on the cap.

876,639. ELECTRIC SAD-IRON. Willard M. Harwood, Ontario, Cal. The heating unit is loosely supported within the body of the iron.

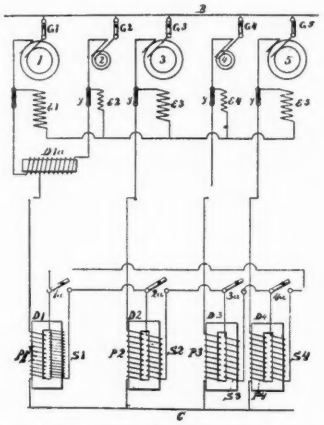
876,641. VOLTAMETER. Henry S. Hatfield, Hove, England. A gas voltameter.

876,649. ELECTRIC RAILWAY. Orlando D. Prescott, New York, N. Y. A swinging frame for the contact shoe.

876,669. TELEGRAPHIC TRANSMITTER. Dana S. Troth, Fruitvale, Cal. A keyboard transmitter.

876,686. MEANS FOR OPERATING ALTERNATING-CURRENT MACHINES IN PARALLEL. Morgan Brooks and Milton K. Akers, Urbana, Ill. The machines are connected in parallel through transformers and synchronizing reactance coils.

876,700. TROLLEY HARP. Benjamin L. Dresser, Uxbridge, Mass. Spring clips on the pole engage in the harp.



876,686.—Means for Operating Alternating-Current Machines in Parallel.

876,701. ELECTRIC SWITCH. Heinrich Drewell, Charlottenburg, Germany. A selective system for controlling a plurality of electric devices.

876,722. TROLLEY. Joseph H. Kroen, Monaca, Pa. Guard arms extend over the wheel.

876,804. ELECTRIC SAFETY SYSTEM. Homer A. Hill, Delafield, Wis. An electrically controlled system for operating a tripping lever.

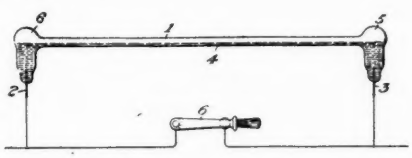
876,809. ELECTRIC SWITCH OR CUTOUT. Isidor Kitsee, Philadelphia, Pa. The switch is opened by tilting the enclosing case.

876,828. INSULATOR. Ross C. McNutt, Mendota, Ill. A metallic cap is attached to the bottom of the insulator by members anchored in the insulating material.

876,862. METHOD FOR THE CEMENTATION OF STEEL. Cleland Davis, U. S. Navy, assignor, by mesne assignments, to Carnegie Steel Company, Pittsburg, Pa. The surface of the plate is heated by a heavy electric current.

876,882. CIRCUIT-CONTROLLER FOR ELECTRIC MOTORS. John M. Joy, New York, N. Y., assignor to Page Machine Company, New York, N. Y. The circuit is opened after the motor has made a predetermined movement.

876,886. CABLE TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa., assignor of one-half to William J. Latta, Philadelphia, Pa. Two local circuits are respectively controlled by the direction of the current in the cable.



876,918.—Circuit-Breaker.

876,910. ELECTRIC SWITCH. Charles G. Perkins, Hartford, Ct., assignor to the Perkins Corporation, Hartford, Ct. A combined switch and fuse.

876,918. CIRCUIT-BREAKER. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York, N. Y. A circuit is opened by the volatilization of a thin column of mercury.

876,922. ELECTRIC LAMP. Joseph de Martino, Breesport, N. Y., assignor of three-tenths to Charles B. Davis and three-tenths to Charles H. Kinley, Breesport, N. Y., and one-tenth to James Francis Burke, Pittsburg, Pa. A method of constructing incandescent lamps.